Optimizing Knowledge Management for Change and Innovation in the Council for Scientific and Industrial Research (CSIR) –Ghana

By

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Abstract

In an era where knowledge is increasingly seen as an organization's most valuable asset, many firms have implemented knowledge-management systems in an effort to capture, store, and disseminate knowledge across the firm. The creation and transfer of knowledge in an organization has become a critical factor in an organization's success and competitiveness. Many organizations are now concentrating their efforts on how knowledge, particularly tacit knowledge that exists in the organization can be transferred across the organization. Transferring of knowledge means knowledge is conveyed from one place or person to another. Generally, when something is being transferred, someone will gain it and someone else would lose it. However knowledge which is regarded as an intangible asset is different from tangible assets. Tangible assets tend to depreciate in value when they are used but knowledge grows when used and depreciates when not used. (Sveiby,2001). This means that knowledge will keep on growing whenever a person shares the knowledge that he or she has; but for knowledge to be shared successfully, it requires the willingness of employees and work groups to display a high- level of co-operative behavior.(Goh, 2002).

Knowledge management is an ongoing process and it has to be organized in a manner that is always open to new ideas. Knowledge is the most decisive organizational resource in the organizational structure of institutions which should be used and organized systematically in order to enhance efficiency and effectiveness. Knowledge management is a concept that was coined as an advanced management concept for the most important of all organizational resources and intellectual capital. Research organizations, computer companies and high-tech corporations recognized the tremendous importance of intellectual capital and believe that developing and investing in intellectual capital is the critical path for organizational success. Unlike the traditional assets of an organization, the quality of an organization's Knowledge is evidence of future ability to earn profits and maintain an ongoing relative advantage that distinguishes the organization from its competitors. Organizations that understand the importance of knowledge learn to identify, map, nurture and preserve it. Managing knowledge is different than managing other resources; it requires a different kind of thinking: thinking

about thinking (meta-cognition) and breaking out of standard management frameworks. Unlike tangible resources, knowledge is very difficult to capture and define, not to mention manage

In recent times, it has become imperative for organizations to incorporate innovations into their corporate policies. Modern organizations must constantly adapt to survive in today's rapidly changing environment; stagnant organizations that cannot innovate to meet evolving environmental conditions will eventually and itself no longer be competitive in an increasingly complex and technologically sophisticated economy. For an organization to be successful in innovation it needs vision that is what it wants to be. To be innovative in highly competitive industries and global markets requires the effective use of Knowledge Management but the appropriate environment has to be in place before people will be motivated to input and access such systems. The willingness to share knowledge between individuals is directly affected by the culture within a company.

A survey research method was adopted for the purpose of collecting data for this study. A questionnaire was structured which was used as a guideline for collecting data. The researcher held informal relaxed conversations with the respondents who were allowed to freely give additional information outside the information provided on the questionnaires. The respondents held various positions with majority of them been scientific researchers. The researcher considered the respondents to be creators and users of knowledge in the organizations. The researcher scanned through relevant documents that the organizations availed for additional.

The study established that although there are no formal structures for managing knowledge in the organization, a large amount of knowledge flows through the organization and there are several knowledge management activities carried out by staff who hold knowledge management-related positions; the concept of knowledge management is regarded; there are no standards set for determining the knowledge required in the CSIR and that there are no particular formats in which the knowledge should be delivered; the CSIR do not have sophisticated, modern electronic tools for managing knowledge as advanced information and

communication technologies for effective knowledge management has not been well exploited; organizational learning is encouraged; and the organization face a number of challenges and problems in managing knowledge. Some of the problems and challenges are unique to the CSIR while others are universal and may be experienced by other research .organizations Recommendations of the study included the incorporation of knowledge management practices and procedures; identifying the importance of expertise available in the CSIR; changing the organizational culture and management procedures; importance of the acquisition of advanced information and communication technologies and developing a strategic km road map.

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Any imprecision, misreporting or omission in this work should be entirely attributed to me as the author of the work.

Acronyms and Abbreviations

CSIR	Council for Scientific and Industrial Research
KM	Knowledge Management
NRC	National Research Council
R& D	Research and Development
OECD	Organization for Economic Co-operation and Development
IT	Information Technology
OSN	Online Social Networking
CoP	Communities of Practice
IC	Intellectual Capital
JICA	Japan International Cooperation Agency
USAID	United States Agency for International Development
EU	European Union
FAO	Food and Agricultural Organization
CARGS	Competitive Agricultural Research Grant Scheme
WAAPP	West Africa Agricultural Productivity Program
STEFUND	Science and Technology Research Endowment Fund
CORAF /WECARD	West African Council for Agricultural Research & Development

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1.0 CHAPTER ONE: INTRODUCTION TO THE STUDY

This chapter introduces the main issues that relate to the study. It provides a brief overview of the main concepts underpinning the research project; it outlines the rationale for the study and the research questions that served as framework for the study; and it finally outlines the structure of the dissertation.

1.1 Introduction to Knowledge Management

Knowledge management could simply be defined as "retrieving the right information for the right people at the right time" (O'Dell and Grayson, 1997), and to achieve this, it comprises a range of strategies and practices used in an organization to identify, create, represent, distribute, and adopt insights and experiences. Such insights and experiences comprise knowledge, either embodied in individuals or embedded in organizational processes or practice. Knowledge management thus embodies the range of activities in which an organization consciously and comprehensively gathers, harvests, organizes, shares, leverages and analyzes its knowledge in terms of resources, documents, and people skills. It implies continuous and ongoing renewal of organizational structures to anticipate the future opportunities and threats. (Chen, 2009).

Knowledge management, therefore, provides a planned and structured approach to managing all facets of knowledge and its application as an organizational asset to enhance an organization's capabilities. This is always done within the parameters of the organization's overall strategy and usually takes place on three levels;

- individual level,
- team level and
- Organizational level.

Parlby and Taylor (2000) are of the opinion that knowledge management is mostly about supporting innovation, the generation of new ideas and the exploitation of the organization's thinking power. Knowledge management also includes capturing insight and experience to

make them available and useable when, where and by whom it is required. Knowledge management thus allows easy access to expertise and know-how, whether it is formally recorded or in someone's mind. It further allows collaboration, knowledge sharing, continual learning and improvement. It thus underpins better quality decision-making and ensures that the value and contribution of intellectual assets, as well as their effectiveness and their exploitation, is well understood.

Darroch and McNaughton (2002) indicate that knowledge management is a management function that manages the flow of knowledge and ensures that knowledge is used effectively and efficiently for the long-term benefit of the organization. An organization that demonstrates competence in knowledge management has a knowledge-orientation and this then becomes the guiding philosophy that influences all organizational strategies.

It was seen above that one of the important benefits of knowledge management is that it fosters and promotes innovation. According to Chen et al. (2004) innovation refers to the introduction of a new combination of the essential factors of production into the production system. Innovation capital is the competence of organizing and implementing research and development, bringing forth new technologies and new products. Cardinal et al (2001) indicate that the innovation process encompasses a combination of technical, physical, and knowledge-based activities that are central to forming new product development routines.

Cardinal et al (2001), in turn, defines innovation as a knowledge process aimed at creating new knowledge geared towards the development of new and viable solutions – it is the adoption of an idea or behavior that is new to the organization and which creates new products, new services or new technologies.

Innovation is intrinsically related to change, which can be radical or incremental. Organizations use innovation as a tool to influence an environment or as a mechanism to adapt to changing environments, internal and external. Innovation is, therefore, of importance to all organizations

in the changing environment of the 21st century and they have to ensure that their organizational strategies are sufficiently innovative to survive and grow in the current environment and sustain a competitive advantage. Innovation has, however, become increasingly complex due to changing client needs, extensive competitive pressure and rapid technological change (Cavusgil et al., 2003). The complexity of innovation has also been increased by growth in the amount of knowledge available to organizations as basis for innovation. Innovation is very dependent on the availability of knowledge and this dissertation thus aims to clarify how the optimization of knowledge management could lead to innovation and change in the Council for Scientific and Industrial Research (CSIR) in Ghana. In order to facilitate this, the definition, concepts and nature of knowledge management, innovation and factors related to them will be outlined in chapter three. In the following sections a brief overview is given of aspects closely related to knowledge management.

1.2 The Knowledge Economy

The knowledge economy is a fairly recent phrase in the management literature from about the mid-1990's that refers to the role that knowledge application plays to ensure economic growth and sustainability. It is thus clear that knowledge management is then an important factor in the knowledge economy to ensure that knowledge is effectively leveraged and utilized. To understand why knowledge management has grown in importance in recent years, it is thus necessary to look at the economic context within which it is developing (Morrow, 2001:389). According to Morrow the following themes distinguish the knowledge economy:

- the key industries in this new economy are knowledge-intensive and heavily dependent on knowledge workers;
- as a consequence of globalization, competitive advantage between nations rests on the extent to which they can develop their knowledge industries and knowledge workers;
- the knowledge component of all industries is increasing and the value added comes from the substitution of physical resources for intangibles;

- developments in technology, especially information and communication technologies are altering the economic bases of at least developed countries.

Davenport and Prusak (1998:17) emphasize that production of ideas and not goods is the source of economic growth. Morrow (2001:390) also credits technology for facilitating growth in that it allows ideas in the form of techniques, research results, and protocols to be globally distributed. Technology has also enabled industries to globalize, relocate and take advantage of low-cost, low-skilled labor elsewhere while still coordinating and controlling operations from home base. Technology has further facilitated the development of a new range of industries based primarily on the production of information and knowledge.

1.3 Organizational Learning

This study addresses the issue of organizational learning in regard to its connection to knowledge management. Gorelick, Milton and April (2004:25) aptly state that knowledge management is not an end in itself. The goal of knowledge management is to increase organizational performance through learning by ensuring that each operational decision is made based on relevant knowledge and experience. Gorelick, Milton and April further argue that in learning organizations, individuals, groups, and teams continuously engage in new processes to acquire, capture, store, disseminate and reuse knowledge. For that matter, knowledge management programmes, processes, and tools support organizational learning and address more than the sum of knowledge of each member of the organization or the sum of individual learning. So, it may be asserted there is a relationship between an individual's learning and the collective learning of the organization - individual learning on its own is, however, not sufficient to produce the systematic knowledge required for organizational survival and development (Gorelick, Milton and April, 2004:26).

In showing how strongly knowledge management and organizational learning are linked, Garvin (1993:80) defines the learning organization as "an organization skilled at creating, acquiring and transferring knowledge and at modifying its behavior to reflect new knowledge and insights."

Based on this definition one can also say that in a learning organization, members of the organization are expected to collectively acquire new knowledge, skills and capabilities.

1.3.1 Learning Culture

A learning culture may need to be created before organizational learning takes root. The issue of a learning culture and how such a culture may be cultivated are important factors for the CSIR and for this study. Organizational learning needs a culture changeover (Gorelick, Milton and April, 2004:51). There may be a need for new technologies and procedures but a more fundamental requirement is organizational cultural change in the way that knowledge is perceived. If employees are made to believe that knowledge is an n important strategic organizational resource, then they will use every available technology and opportunity to learn and share knowledge. An organization cannot build a learning culture overnight (Garvin, 1993:90). According to Garvin, most successful examples of building learning cultures are the products of carefully cultivated attitudes, commitments, and management processes that have accrued steadily over time. An organization wishing to build a learning culture should start the process by taking the following fundamental steps:

- Opening up boundaries and stimulating the exchange of ideas.
- This can be achieved by encouraging conference attendance, arranging meetings around common themes of interest or practice and making it a requirement employees work together in project teams working that either cross organizational levels or link the organization and its stakeholders to ensure a fresh flow of ideas.

1.3.2 Knowledge-Friendly and Sharing Culture

Knowledge management thrives in an organization that promotes a knowledge-friendly and sharing culture. This might not occur immediately since such a culture takes a long time to build and according to Gorelick, Milton and April (2004:56), such a culture is encouraged and nurtured; it cannot be dictated or imposed. It is argued by Gorelick, Milton and April (2004:56) that a knowledge-friendly and sharing culture should be based on team work and that working in teams is also an important factor in knowledge management. Gorelick, Milton and April

suggest that it is much more difficult to introduce knowledge management and to achieve desired results in organizations where employees work individually, where there is no performance management system, or even where work is not organized into projects with goals, objectives and deadlines.

It should, however, also be noted that much as an organization may wish to establish a culture which embraces knowledge sharing and learning, there may be many cultural barriers which may prevent it. The CSIR has thirteen different institutes and it may be no wonder that knowledge sharing does not readily occur amongst the employees. According to Gorelick, Milton and April (2004:53) many of the main cultural barriers to learning and knowledge sharing are embedded in the beliefs of individuals and the organization and they thus suggest that to overcome these barriers and organization should consider the following factors:

- **The belief that individual knowledge is power.** This belief is common in an organization which has a lot of internal competition, where knowledge is managed by leaving it in the heads of experts as tacit knowledge. People need to be made to see that by sharing knowledge they actually acquire greater power.
- **Edge to innovate.** Some organizational cultures are built so strongly around the principle of innovation and creativity that there is a strong cultural barrier when it comes to the reuse of knowledge and information. This culture can be so powerful that even when a successful solution to a problem exists, people would still seek to do things differently so that they can be seen to be more creative. People in an organization need to be made to realize that while innovation is good, reinvention is a waste of time.
- **Individual work bias.** In organizations where employees work as individuals, with individual objectives and rewards it is more difficult to create a culture of learning and sharing and also to implement knowledge management. Knowledge management generally flourishes where there is an organizational culture where collaboration and cooperation are the norm and where employees work in teams and communities and are rewarded for collective performance. In a culture where employees are rewarded

only for individual performance, anything that compromises individual performance (such as spending time sharing knowledge with others) tends to be ignored.

- **"It's been done before"** This is a major cultural barrier to knowledge sharing. Individuals prefer their own solutions to anybody else's solution because they trust something they have created themselves. This barrier is largely as a result of lack of familiarity with the people who offer knowledge, and therefore there is mistrust of the knowledge they offer. Management should look for ways of bringing individuals together and to build trust.
- **Don't see the value.** Some employees are likely to see no value in engaging more actively with knowledge. A knowledge manager may address this kind of barrier by telling success stories of where knowledge has added value by being managed. An alternative is to share negative stories of where value has been lost because of not managing knowledge. Eventually, the mind set and culture should change to one where knowledge is seen as a key resource.
- **No incentive in sharing.** Knowledge management needs to be embedded into other management processes, such as project management, so that it becomes part of the job rather than an added-on job. Employees should be given incentives for sharing, either through monetary or other reward systems. Managing knowledge should be looked upon as part of being paid to do the job. As soon as knowledge management is seen as part of the job, it becomes part of the reward structure as well.

It is thus clear that if for any reason an organizational culture does not support knowledge creation, processing, and sharing, the introduction of a knowledge management programme is likely to fail. An important aspect that this research project should thus investigate is the extent to which the organizational culture in the CSIR supports these aspects.

1.4 Information and Communication Technologies (ICTs) and Knowledge Management

Information communication technology has often been given the credit for effective and efficient knowledge management. It has even been thought that when an organization has an ICT system in place, it is the same as having a knowledge management programme in place. However, information and communication technologies should only be viewed as enabling tools for knowledge management. Organizations in Ghana may thus be seen as not having good knowledge management programmes merely because of a lack of advanced information and communication technologies.

Knowledge management is, however, more about people and organizational culture than it is about technology. Ichijo (2004:126) argues that knowledge is a social product, generated by a close interaction among people. He explains that knowledge must be generated in a truly empathetic environment, where people care for individual experiences. The researcher, therefore, kept this factor in mind while investigating knowledge management practices at the CSIR.

Having shown the danger of over-emphasizing the importance of ICT's in knowledge management, it should also be stated that information communication technology is a very useful enabler in knowledge management. It can be used in a number of ways to facilitate the practice of knowledge management. For example, it can be effectively used to create document repositories that can be shared and re-used, make available lists of subject matter experts and provide access to knowledge with speed and in time (Lank, 1997:411). According to Teece (1998:60), information communication technology is dramatically assisting in the sharing of information and knowledge. Teece further argues that ICT's make it possible to much more readily capture and share organizational learning and experience. Knowledge learned in the organization can be catalogued and transferred to other applications within and across organizations – it thus enables rich exchange to take place inside the organization and overcome many structural barriers. In order to facilitate the sharing of knowledge it thus

generally recommended that a strong information technology infrastructure should be in place (Lank, 1997).

Information and communication technologies, however, need to be integrated and related to organizational culture so that they may effectively be used to assist with various knowledge management practices. The researcher will thus investigate these factors and also the level of development of the ICTs in the CSIR and how best they may be used to support organizational knowledge management. It should, however, also be noted that organizations in Ghana (as anywhere else in the world) would not invest in any costly technology if they were not sure of its benefits. They would thus have to be assured of both the short-term and long-term benefits that would accrue before investing in any new technology.

1.5 Problem Statement and Rationale of the Study

The twenty-first century has beyond a doubt become a knowledge society where the effective leveraging of knowledge or intellectual capital dictates the success of organizations. The creation, acquisition and distribution of knowledge are matters of considerable importance for organizational performance and of increasing importance for modern technological societies. Knowledge unlike other assets grows when used. It is further apparent that in organizations today, knowledge and information and communication technology tools are closely interlinked.

This study therefore focuses on whether the Council for Scientific and Industrial Research in Ghana is effectively and efficiently creating, acquiring, distributing and using knowledge. The study will also investigate the role of information communication technology in the process.

The researcher has had long-term interaction with the CSIR in Ghana and during this time she has observed that the senior management of the CSIR possesses substantial knowledge that they have acquired through education and training, conference attendance and research. The researcher has, however, further seen that this knowledge is not disseminated throughout the organization. Nobody seems to know who in the Council has what knowledge and furthermore

who needs what knowledge and how such knowledge should be delivered. Another aspect that she has observed was that the thirteen different institutions of the Council generate and keep knowledge in their own silos. This leads to duplication of efforts and cost. It also came to the researcher's attention knowledge is not in any meaningful way being connected to the strategic processes at the CSIR and so little support or priority is given to the support of knowledge management programmes. Again, the potential of information and communication tools (ICT) have not been considered to improve the activities of the employees as well as the dissemination of knowledge acquired.

Given that knowledge is now considered an important factor of production and wealth creation in the knowledge society, there is thus an urgent need to consider how knowledge should be managed effectively in the CSIR to enable quality service delivery as well as to achieve a competitive advantage in the current global economy, where knowledge rather than natural resources, labor and capital are considered the basic economic resources. The researcher, thus, argues that the lack of knowledge management and the resultant low level of knowledge sharing in the CSIR might be having a negative effect on productivity and service delivery

Based on her working knowledge of Ghana's CSIR and the literature in the field of knowledge management, the researcher has, therefore, realized that for knowledge to be exchanged and successfully leveraged in the CSIR, the following factors and prerequisites should be in place:

- The CSIR should become more receptive to change, as this would promote the development of fresh ideas, innovation and up-to-date information, all of which will make it possible for the organization to build a trusting knowledge sharing culture with its stakeholders.
- There should be a level of trust and common ground for knowledge to be shared effectively in organizations. Thus, a knowledge sharing culture should be developed that encourages employees to want to share their knowledge on relevant issues which are related to the organization without any intimidation. (Kasper-Fuehrera and Ashkanasy, 2001).

- An environment should be established that encourages informal and formal knowledge exchanges. This would help managers reframe their perspective of where and how work gets done. Such environments emphasize the view that quality of ideas is more important than the status of the source. (Holloway, 2000).
- The council should ensure that there is a common language and understanding among all employees to promote knowledge sharing. Without establishing such a common agreement on vocabulary and context, it would be difficult for knowledge to be shared and applied. This could be done through team working, job rotation or division of labor. In doing this, employees develop tolerance for other opinions. (Hildreth et al, 2000).
- The CSIR should pay attention to how knowledge is exchanged and leveraged to ensure that they always gather accurate information. They should be aware of globalization and move away from only relying on organization-based information. Employees should be empowered to search globally for expert knowledge.
- There should be recognition mechanisms for those who actively contribute their knowledge and reuse it (e.g. in a form of promotion, presentation, or that their names published on the information they have contributed). In this way morale is boosted, and the willingness is created for more knowledge to be shared. (Robertson and De Brún: 2005).

1.7 Significance of the Study

The researcher is of the opinion that by conducting this study possible ways of improving knowledge management in the CSIR's practices and procedures would be revealed. A further factor is that no evidence has been found that a similar research project relating to knowledge practices has to date been undertaken in Ghana.

The results of this study would generate findings that relate to the knowledge and information needs of the employees, especially the researchers in the council, and further it would provide pointers as to how such needs could be met by means of sound knowledge management

practices. It would hopefully also provide an opportunity for further research to be done in this subject area.

1.8 Aim and Objectives

The aim of this research project is to investigate how knowledge is shared within Ghana's CSIR and with other stakeholders in order to increase the quality of products and services, and promote innovations. Based on the investigation and recommendations that evolve, the best knowledge management practice model could be implemented in the CSIR.

The objectives would be to

- Investigate the extent to which the employees in the organization are motivated to contribute to knowledge creation and sharing; and discovering the challenges and problems the organizations face in managing knowledge.
- Explore the use of ICT tools such as portals, social networking tools, Google's shared documentation tool, etc. in knowledge dissemination among CSIR employees and its stakeholders.

1.9 Research Questions

In fulfilling the research objectives of the study, the following key research questions were formulated to guide the investigation.

- Are the cultural and social practises at the CSIR conducive to knowledge management and the generation, acquisition, use and sharing of knowledge?
- Are the CSIR's organizational practices and procedure assisting or inhibiting the interaction with knowledge and the practice of knowledge management?
- Does the CSIR have an adequate information communication platform that is utilised to leverage knowledge management practises?

1.10 Research Methodology

The study adopted a qualitative research approach and employed the survey and interviewing techniques as the primary tool for the collection of the data needed to answer the research questions outlined above. Based on these research questions, detailed questions were developed and incorporated into a questionnaire that served as the framework for the interviews that were conducted (cf. Appendix A). The questions addressed key issues that related to both the explicit and implicit knowledge of the organization and specifically explored what information resides in the organization; the information technology infrastructure; the culture of the organization; perceptions that individuals have in relation to interaction between themselves and the organization; and the core organizational processes.

1.11 Scope and Limitation of the Study

This study was solely based on a government-owned research organization in Ghana considered to be knowledge and information rich. The hierarchical structures, bureaucracy, traditional roles of management and the slow pace of adopting technological changes and managerial styles at the CSIR offered an excellent opportunity to assess the practices, procedures and challenges of organizational knowledge management in the Council for Scientific and Industrial Research.

This study focused on practices, procedures and challenges of organizational knowledge management. A wider sample would have been interesting, but time and financial resources would not allow this. A wider sample would have expanded the study to a size that could not be manageable considering the time and financial resources which were available to the researcher. The study may not have made a detailed evaluative study of practices, procedures and challenges of organizational knowledge management in CSIR in Ghana, but it may serve as a good starting point or research into several aspects of organizational knowledge management.

1.12 Resources Consulted

Literature was reviewed from journals, both electronic, hard copies and research publications. The researcher made every effort to refer to the most applicable publications on several aspects in knowledge management. The major source of current publications in knowledge management was the Internet. Some specific databases were consulted to provide the required information. Among the databases consulted and searched were Emerald, Insight services, EBSCOhost, Science Direct, Communication of Association for Information Systems and JSTOR Business Collection databases. The University of Cape Town Library had very useful journals and books on knowledge management which was consulted and where the books were not available at the library, it was obtained through the inter-library loans arrangement.

1.13 Organization of the Dissertation

This dissertation is divided into seven chapters as follows:

Chapter 1: Introduction to the study

The aspects covered were: Conceptual setting of knowledge management, organizational learning, problem statement, rational of the study, significance of the study, aim and objectives, research questions, research methodology, scope and limitation, resources consulted and organization of thesis.

Chapter 2: The Background of the Organization

The aspects covered were: History, mission and vision, Structure of the organization, financial dependency of the organization, Dissemination of research findings.

Chapter 3: Concept Clarification and Issues in Knowledge Management

The aspects covered were: Review of related literature under various broad headings i.e. Knowledge Management; Organizational Knowledge Management; Tacit Knowledge; Explicit knowledge; Organizational Learning, Organizational Assets, Competitive Advantage, KM and Social networking, ICT, Strategy and Leadership, KM and Innovation, Organizational Structure, Trust and Communication.

Chapter 4: Theoretical Framework

The aspects covered were: Theories of Knowledge Management, Definitions of Operational Concepts, Contextualizing Framework, Limitations and Proposed KM Framework for the study.

Chapter 5: Research Methodology:

The aspects covered were: Detailed explanation of research design and methods, Target population, Research techniques and instruments, Data collection procedures and problems, Ethical considerations.

Chapter 6: Data Analysis, Interpretation and Presentation

The aspects covered were: Interpretation of data using Tables, Charts, Figures and Description.

Chapter 7: Discussion of Research Findings, Road map, Conclusions and Recommendations

The aspects covered were: A summary and discussion of important and relevant issues arising from the research findings, Proposed Knowledge Management Roadmap and Strategy, Recommendations and Conclusion.

References

Appendices

1.14 Conclusion

This chapter gives the general introduction to the study. It discusses the concept of knowledge management and other related concepts in general. It further provides the context for the study and brief a background of the environment in which the Council for Scientific and Industrial Research operates. The chapter sets the aim, objectives and research questions raised in the research project, the rationale, significance and the limitation of the study. The next chapter is on the background of the targeted organization

2.0 CHAPTER TWO: THE BACKGROUND OF ORGANIZATION

In this chapter a synopsis is given of the target organization that is the Council for Scientific and Industrial Research (CSIR), in which investigations of how knowledge was managed and disseminated was conducted.

2.1 The Target Organization

Introduction

This overview of the CSIR serves three purposes. It firstly provides a clear understanding of the organization, its core business schedule, and the organizational culture and structure. Secondly, the overview informs the framework that is developed for the knowledge management of the organization. Thirdly, this overview will form the basis for the recommendations that will emerge and be embedded in the Knowledge Management plan that the organization can adopt. The literature informing this chapter is sourced from the researcher's interaction with scientists and some general support staff who acted as key informants. The CSIR website http://www.csir.gh.org was a key source of information relating to all its programs and travel schedules. Throughout this study, the organization Council for Scientific and industrial research shall be referred to by the acronym CSIR.

2.2 History, Mission and Vision

"The Council for Scientific and Industrial Research (CSIR), Ghana was established in its present form by the National Liberation Council Decree 293 of October 10, 1968 and re-established by the CSIR Act 1996 (Act 521) on November 26, 1996. However, the Council traces its ancestry to the erstwhile National Research Council (NRC) which was established by Government in August 1958 to organize and co-ordinate scientific research in Ghana with the mission to:

- "Promote and strengthen strategic partnerships with relevant stakeholders to enhance the generation of solutions to challenges in agricultural research, technology development and transfer.

- Improve institutional capability to undertake effective research and service delivery to enhance agricultural productivity.
- Enhance research and technology delivery through efficient mobilization and management and operating procedures and systems as a means of ensuring efficiency in research delivery."(http://www.csir.org.gh/)

A major factor obstructing the effective introduction of knowledge management practices in the CSIR is that the Council has thirteen institutes all reporting to the headquarters. This makes it particularly embedded in bureaucracy and there are thus very few incentives that encourage employees to generate, distribute and share knowledge. Many employees in the CSIR are conventional career public servants, who cannot envisage and appreciate the potential of knowledge management and the benefits of knowledge leveraging. They are also suspicious of sharing knowledge, as they think that by hoarding knowledge they enhance their value and competitiveness.

2.3 Structure and Organization

For the co-ordination of nationwide research, the Council has established thirteen different institutes which fall under three main sectors as provided in the CSIR Act:

- Agriculture, Fisheries and Forestry
- Health and Medicine and Environment
- Industry, Natural and Social Sciences

Each of the institutes operates under a Technical Division of the CSIR Secretariat which considers and approves the research and commercialization programmes drawn up by the Institutes and monitors their implementation. The Thirteen institutes are namely:

"Animal Research Institute (ARI) undertakes research aimed at providing solutions to problems relevant to the livestock industry in Ghana, and to advise government through the CSIR on livestock production policy matters"

"Crop Research Institute (CRI) conducts quality research to generate technologies that would ensure sustainable and environmentally friendly crop production and to develop appropriate strategies to disseminate research information".

"Food Research Institute (FRI)

Assist in poverty alleviation, contributes to food security, foreign exchange earnings and the application of cost-effective food processing technologies that are environmentally friendly".

"Oil Palm Research Institute (OPRI)

Improves breeding of oil palm and coconut development of land use efficiency and intensification strategies to maximize yields and enhance yield potentials".

"Savanna Agricultural Research Institute (SARI)

Develop in close collaboration with typical farm households to enhance the capacity of farm families to increase crop production per unit area without injury to the environment".

"Institute of Industrial Research (IIR)

Transfers appropriate technologies as well as provide consultancy services to small and medium scale industries and other stake-holders in Ghana and the West African sub-region".

"Building and Road Research Institute (BRRI)

To profitably provide research and development products, processes and services to the building and road sectors and for the socio-economic development of Ghana".

"Institute for Scientific and Technological Information(INSTI)

Develops an efficient system for the bibliographic control of existing and current indigenous scientific and technological literature through the creation of databases for the national network system".

"Science and Technology Policy Research Institute (STEPRI)

Provides the research support necessary for the formulation and implementation of a comprehensive Science and Technology policies programmes".

"Soil Research Institute(SRI)

Strengthen the Institute's delivery capacity for increase agricultural production and establishing and strengthen linkages with local and international collaborating agencies".

"Water Research Institute (WRI)

Generates and provides scientific information, strategies and services towards the rational development, utilization and management of the water resources of Ghana".

"Plant Genetic Resources Research Institute (PGRRI)

To encourage the utilization of the conserved resources by appropriate users such as plant breeders, researchers and farmers".

"Forestry Research Institute of Ghana (FORIG)

"Undertakes forest and forest products research to ensure sustainable management and utilization of Ghana's forest resources and to engage in the commercialization of the research results and services" (http://www.csir.org.gh/)

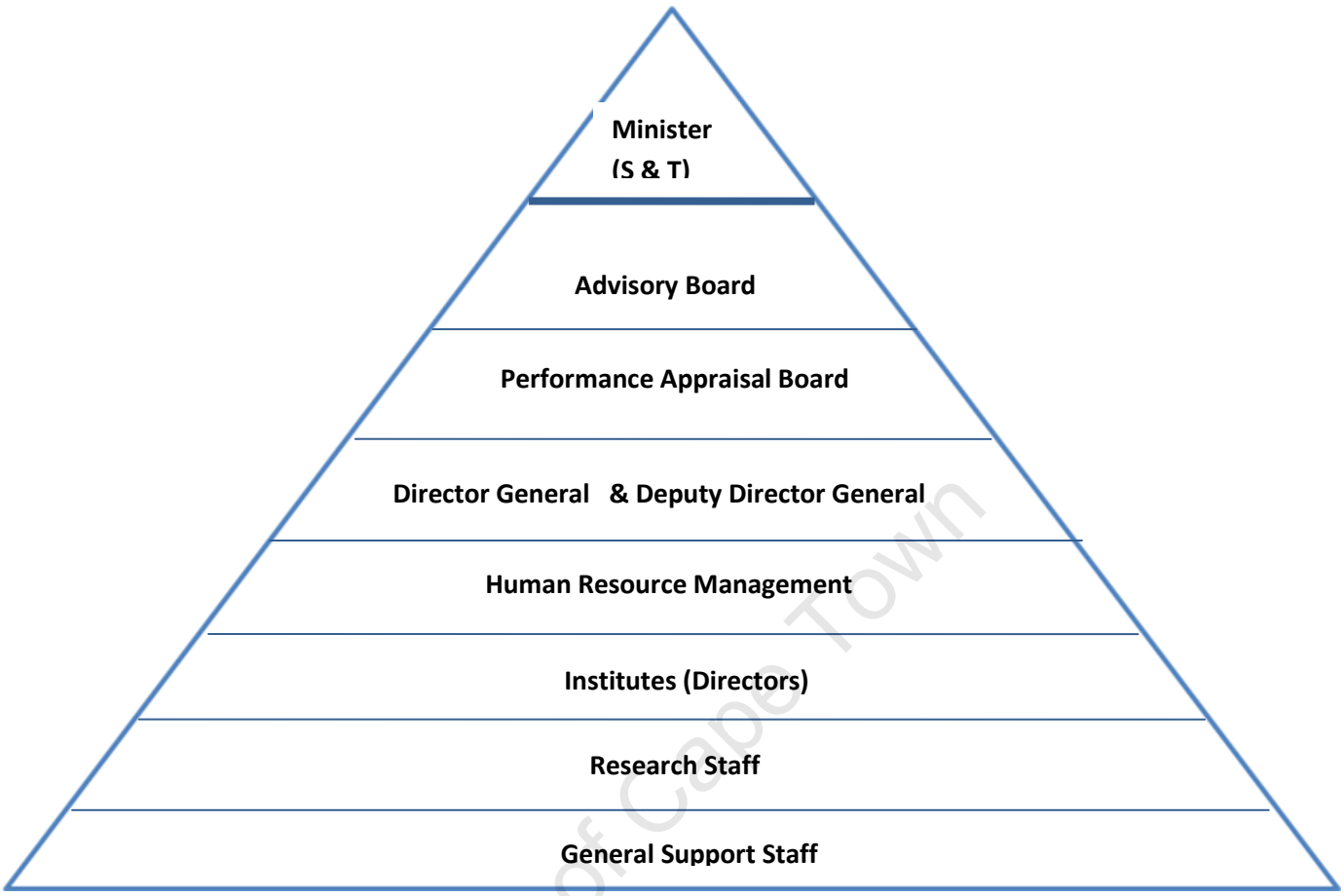

FIGURE 2- 1: CSIR's Organizational Structure. Source: Author

Knowledge organizations seek to identify, generate and retain organizational knowledge to ensure competitive advantage. Organizational structures influence the way; power and responsibility operate in a firm and by implication, the way knowledge can be disseminated and adopted by others. CSIR like most organizations with structures has grouped its employees according to functions or divisions in the various institutions, these structures creates some cooperative action within a specific domain but it can decrease the capacity to interact with and learn from others working in different fields and departments. This form of structure is often used by organizations with hierarchical process for communication, decision making and performance accountability. This structure forms barriers to effective communication such as

- Rivalry between departments withholding information

- Departments can become very specialized and would find it difficult to share information with other because of the technical terms involved
- Departments become isolated and are not encouraged to share
- Staff members are not rewarded for sharing informing (Holloway, 2000).

2.3.1 Financial Dependency of the CSIR

Research and development (R&D), according to the Organization for Economic Co-operation and Development (OECD), refers to the creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new application

CSIR unlike a lot of research institutions in Africa relies mostly on external funding for research activities, mainly because the government support is not sufficient to cover comprehensive research projects. The main source of funding is predominantly based on donations from international agencies such as Japan International Cooperation Agency (JICA), United States Agency for International Development (USAID), European Union (EU), Food and Agriculture Organization (FAO).

Funds are also received through loans from the World Bank and guided by the 1980 Agricultural Research Systems. The Bank's assistance to agricultural research increased significantly over the 1980-95 period, averaging $200 million annually in the 1990s compared with $150 million in the decade before. The Bank is now the major external source of funding for agricultural research in developing countries. (http://www.csir.org.gh/)

The council also generates funding through its own sales of goods and services. The Oil Palm Research Institute (OPRI) of CSIR generated about 30% target of its research funding through sale of germinated oil palm seedlings. While the other institutes such as the food institute generates around 5%.

2.3.2 Other Sources of Research Funding

- Competitive Agricultural Research Grant Scheme (CARGS) which successfully funded 193 research projects.
- West Africa Agricultural Productivity Program (WAAPP) by the world bank and coordinated by West and Central African council for agricultural research and development (CORAF/WECARD) has been supporting tubers and root research.
- Science and Technology Research Endowment Fund (STREFund) managed by CSIR was established in 2007 to provide supplement funding from both private and public source to support research in Science and Technology in Ghana.

2.4 Dissemination of Research Findings and Knowledge

CSIR actively disseminates its research findings by means of a variety of publications that range from books, conference proceedings, research reports, occasional papers, policy briefs, newsletters to the secretariat's information bulletins which are of a high quality in content. CSIR however, also actively encourages its research scientist to publish journals as well as organize and attend training programs. Some of the published work is a result of collaborative efforts between researchers of the organization and external experts, and copies of these publications resides in the libraries of the various institutions and can be used as reference materials.

Conferences, workshops and seminars are other key forums that provide avenues for dissemination, sharing and debate on research findings and on matters relating to Agriculture, Fisheries and Forestry, Health and Medicine and Environment as well as Industry, Natural and Social Sciences. CSIR makes use of technological platforms such that the organization has launched a website on which the following information about the organization can be found: staff members, their areas of expertise and contact details, current news, upcoming events, publications and new innovations. Through the website, the organization is seeking for a global

presence which may attract collaborative and network partnerships. A number of databases are held internally by the institutions such as the contacts database for partners and collaborators. CSIR also deploys the services of the media to inform the public of new inventions

2.5 Conclusion

The CSIR in Ghana, like most research institutions in the sub-Saharan Africa region and in contrast to many research organizations in the developed world has not as yet productively integrated knowledge management into their business strategies. This tardiness can be attributed to the fact that knowledge is not leveraged effectively and because Ghana lags behind the developed world as far as the application of information and communication technologies and the introduction of e-business.

This paper seeks to explore the role that knowledge management (KM) can play and what KM practices can support the CSIR's performance effectiveness and service delivery in collaboration with other research organization, such as the universities in Ghana. It further addresses the challenges and problems which act as impediments to introducing KM and stimulating a knowledge society.

3.0 CHAPTER THREE: ISSUES IN KNOWLEDGE MANAGEMENT

Knowledge management is "the explicit and systematic management of vital knowledge and its associated process of creating, gathering, organizing, diffusion, use and exploitation, in pursuit of organizational objectives." Skyrme (1999:59)

This chapter reviews the documented literature on knowledge management (KM) within the following framework:

- main concept clarification;
- the knowledge audit and deploying knowledge management successfully
- main issues relating to knowledge management;
- organizational learning;
- innovation and knowledge management.

3.1 Knowledge Management Concept Clarification

Definitions of Knowledge, Information, Explicit and Tacit Knowledge, and Knowledge Sharing.

It is suggested that these are the key concepts that underpin any knowledge management programme.

Knowledge can be defined as the personal insight, with which one can interpret and apply data and information; it is closely related to the stage of decision making. It can also be seen as an invisible or intangible asset, that is, it is not something that can be touched or felt. Some knowledge exists outside the individual in text format as explicit knowledge, but the majority of knowledge resides within people, making it highly relative, and context dependent.

Plato in his great work on knowledge, the *Theaetetus,* which probably dates from about 369 BC, provides us with one of the oldest discussions on the underlying principles of knowledge (Stanford Encyclopedia of Philosophy, 2009). His view that knowledge can be seen as "justified true belief" has been a topic for debate starting with his student Aristotle views and continuing throughout the ages to present-day philosophers' view on the topic.

It is often stated that there is a continuum of knowledge flow that can be represented as

Data-information-realization-action [knowledge]-reflection-wisdom.

Data represents observations or facts out of context that are, therefore, not directly meaningful (Zack, 1999). Information results from placing data within some meaningful content, often in the form of a message (Zack, 1999). Knowledge, as a "justified true belief", is that which people believe and value and this is generally based on the meaningful and organized accumulation of information (messages) gathered from experience, communication or inference. To obtain information that one needs and to assess the value of information, one has, or needs, to acquire both theoretical and practical knowledge (Kakabadse *et al.*, 2003). An individual only knows what he/she needs to know at the time they need to know it (Snowden, 2002:3).

Information can thus be defined as "facts that have been organized so that they have structure and relationship to the task currently at hand". It is also presented within a context that gives it meaning and relevance and which leads to increase in understanding and decrease in uncertainty. The value of information lies solely in its ability to affect a behavior. Information can also be looked at as a quality of a message from a sender to one or more receivers. In information there should be the existence of a common language understood by the sender and at least one of the receivers. (Wilson and Snyder, 1999).

A further examination of the concept of knowledge has indicated that four types of knowledge can generally be distinguished:

> **Know-of or Know-about**, otherwise known as the operational level of knowledge and it is used as part of an individual's day-to-day work. This type of knowledge is more readily accessible through intranet systems or transmitted through mass communication techniques such as email. (Austin et al, 2008).
>
> **Know-how**:- can also be described as operational level knowledge but within the tacit knowledge domain. In other words it is the accumulated experience of how things work and how things get done in an organization. (Austin et al, 2008).

Know-why: - With know-why the strategic awareness has to be known by employees of an organization in the ever-changing environment, i.e. where the organization is going and why; and lastly,

Know-who: - as a lot of the organization's knowledge resides within individual heads, it is imperative to know who has what knowledge in the organization and this can be unlocked through networking. (Dağli et al, 2009)

A further important distinction is that between explicit and tacit knowledge:

Explicit knowledge: This is generally the term used in knowledge management where knowledge has been externalized, encoded and recorded. It also includes data, information, reports and procedures contained within an information technology system and which is accessible and communicable. This data can be retrieved and explained clearly to others in the organization. (Smith, 2001). Explicit knowledge can also be absorbed through experimentation if the individual remains consciously aware of his/her activities and the resulting outcomes. As long as an individual is consciously aware of the knowledge, its details can be expressed to others and it is therefore considered explicit. Explicit knowledge and information have often, for operational purposes, been equated to each other.

Tacit knowledge, in knowledge management, is a deeper experience - it is the expertise and know- how of individuals and the organization. This knowledge is undocumented and exists in the minds of the employees and in the unrecorded processes of the organization. As it is people who act on knowledge not machines, this reinforces the need to focus on mobilizing, energizing, supporting and enabling all individuals in organizations to combine their know-about and know-how to develop existing services more efficiently as well as creating new services. It seems to be overlooked that knowledge does not always flow because formal structures or systems have been created but instead by means of day-to-day interaction. (Smith, 2001)

Most researchers and practitioners (Nonaka and Takeuchi, 1995) agree that a major part of knowledge in an organization is in tacit form. Smith (2001:311) reports that 90 percent of the knowledge in any organization is embedded and synthesized in people's heads. Tacit knowledge is personal, context specific, and difficult to formalize and communicate (Nonaka and Takeuchi, 1995). It is an ability or skill to do something or solve a problem, which is partly based on one's own experience and learning. Polanyi (1966: 4) concisely sums up tacit knowledge with the phrase ''we know more than we can tell''. Tacit knowledge, unlike explicit knowledge is not easily shared through conventional instruments, such as documents, databases, systems, and processes (Polanyi, 1966). . However, as long as one uses appropriate language, a good deal of knowledge can be shared among people but not all knowledge.

Although, for many persons, tacit knowledge is a new domain about which little is known there is now the beginning of a realization that tacit knowledge is critical to the key organizational tasks of creating new knowledge, generating new products and improving new organizational procedures that lead to innovation. Every organization that seeks to be successful has to create the conditions enabling everyone in the organization to verbalize their tacit knowledge. Each employee should maximize his/her contribution to the pool of ideas that provide a competitive edge for the organization (Kikoski and Kikoski, 2004). A prerequisite for the evolution of tacit knowledge is an open culture in an organization which supports innovation. A culture that supports tacit knowledge enables idea generation, stimulates creativity and has a positive effect on work activities.

Knowledge Sharing: Organizations could foster innovation by encouraging knowledge sharing and the free flow of ideas (Wasko and Faraj, 2000). This would also help organizations understand external demands and the needs of users and or customers. In addition, knowledge sharing brings benefit to organizations in terms of stimulating the development of products and services as well as the development of both vision and strategies (Sanchez and Palacios, 2007). Additionally, knowledge sharing could enhance employee retention rates and minimize the negative effects of brain drain whenever employees leave the organization. This could be done

by recognizing the value of employees' knowledge and thus, rewarding them accordingly (Swart and Kinnie, 2003). When Knowledge is shared effectively, operations could be streamlined and costs reduced by eliminating redundant or unnecessary processes.

Parirokh et al. (2008) have noted that effective knowledge sharing requires adequate technological and cultural facilitation. In many organizations the focus has been on the former aspect neglecting the importance of cultural factors in knowledge-sharing activities. It is, however, argued that one of the most important factors that could influence the success of knowledge sharing is the social trust or mutual trust among members or employees (Chow and Chan, 2008). The social trust in an organization is the foundation that fosters interaction between colleagues and which then results in the sharing of knowledge. A further factor that affects knowledge sharing is whether an environment of honesty exists in the organization, for if this does not occur, competition could be rife among employees and trust would be eroded and knowledge sharing would not occur.

3.2 The Knowledge Audit and Deploying Knowledge Management (KM) Successfully

According to Skyrme (2007), a knowledge audit is an investigation conducted in an organization to uncover important insights about the state of knowledge management in the organization and how knowledge flows in order to improve knowledge sharing. When a good audit is conducted it unearths gaps in knowledge provision, identifies duplication of effort in accessing or maintaining information, indentifies blockages in knowledge flow across the organization as well as identifying the key knowledge holders whose loss would be detrimental to the organization.

A knowledge audit is a discovery, verification and validation tool, providing fact-finding, analysis, interpretation, and reports. It includes a study of an organization's information and knowledge policies and practices, as well of its information and knowledge structure and flow. The knowledge audit examines knowledge sources and use: how and why knowledge is

acquired, accessed, disseminated, shared and used. The knowledge audit will seek to give qualified insight as to whether the organization is ready, especially socially and politically, to become knowledge-based or knowledge-centred (Hylton, 2002b). Such an investigation into the organization's knowledge health is an important step to take to ensure that knowledge will be optimized for innovation in an organization.

Liebowitz et al. (2000), in turn, emphasize the fact that a knowledge audit should be incorporated as the essential first part of any KM strategy development. By discovering what knowledge is possessed, it is then possible to find the most effective method of storage and dissemination. It can then be used as the basis for evaluating the extent to which change needs to be introduced in the organization. An important part of the knowledge audit is capturing tacit knowledge. Capshaw (1999) believes that a knowledge audit should provide the following outputs: an assessment of current levels of knowledge usage and interchange; knowledge management propensity within the enterprise; identification and analysis of knowledge management opportunities; isolation of potential problem areas; and an evaluation of the perceived value in knowledge within the organization.

Skyrme (2007) states that, there are no hard and fast rules for conducting a successful audit since every organizational situation is different. However, below are some guidelines an auditor would want to consider before embarking on an audit process:

- An auditor should be realistic by scaling the audit to the resources that is available; it's better to focus on covering a few knowledge areas or organizational departments properly rather than trying to cover the whole organization.
- Deciding on appropriate data-collecting methods, e.g. questionnaires and/or interviews, and realizing that that each method should be deployed to address different aspects and also to suit the preferences of different people.

- Auditors find the easy bit to be the collection of the data and the tricky bit to be the analysis. It is thus important that the time for analysis should not be underestimated as this can influence the outcome.
- Auditors should be involved throughout the exercise informing the managers, contributors and stakeholders of all the procedures to be taken.
- Before an audit is done, the procedure and which staff would be involved should be discussed with management.

The first major obstacle to deploying KM successfully is that most organizational managers are skeptical about making the necessary investment in KM. The excuse could be about lack of time, resources being too scarce, and lack of appetite for radical change. And yet, public servants are inundated with legal accountabilities that tell them they have to manage all resources, including knowledge and information better. By responding effectively to these kinds of challenges is where KM can show its true value, and in so doing can win the confidence of managers keen to find better and more effective ways of doing the work in the organization.

3.3 Issues in Knowledge Management

3.3.1 Knowledge Management and Collaboration

A common definition and use of the concept relates to the collaborative approach of knowledge management. Knowledge management is essentially about instituting collaboration forums where knowledge can be created and shared. This provides the catalyst that helps decision and actions to be taken based on knowledge shared or created in these forums. Such collaborative spaces or knowledge networks are described by Skyrme (2007) as rich and dynamic phenomena in which knowledge is shared. Knowledge management is thus fundamentally about collaboration and networking. However, other aspects such as IT, culture, learning and performance, all which affect knowledge management are also emphasized as important factors to consider ensuring networking and collaboration.

Collaboration can be seen as the degree to which people in a group actively help one another in their work activities. A collaborative culture affects knowledge creation in that it enables increased knowledge exchange and such knowledge exchange is a prerequisite for knowledge creation. A collaborative culture fosters this type of exchange by reducing fear and increasing openness among members of a team when they investigated the biotechnology industry, found strong evidence supporting the importance of a collaborative culture in fostering knowledge creation. Collaboration between organizational members also reduces individual differences. It can help people develop a shared understanding about an organization's external and internal environments through supportive and reflective communication. Without there being a shared understanding among organizational members, little knowledge is ever created.

3.3.2 Knowledge: An Organizational Asset

Managers have to realize that the most valuable human attributes of their employees should be developed because they are one of the most important assets of any organization. To do so, they need to adopt a new KM philosophy where knowledge is seen as an organizational asset and it is realized that probably the largest proportion of this knowledge is contained in its workers and that they should be valued for the fact that they are the core intellectual competence of the organization. Knowledge workers can only be developed as a true asset if they are supported and efficiently used. Managers should, therefore, purposely organize, motivate and promote the development of their knowledge workers.

Organizational knowledge assets have been identified as sources of competitive advantage. It is therefore critical that organizations understand how they impact on performance in order to effectively manage these assets. Carlucci et al. (2004) show how the management of knowledge assets can positively impact on business performance. It is argued that business performance equates to the value that is generated for the key stakeholders of an organization. The generated value is the result of an organization's ability to manage its business processes. The effectiveness and efficiency of performing organizational processes are, in turn, based on organizational competencies. Again, the management of knowledge assets enables an

organization to grow and develop the appropriate organizational competencies. Therefore, the fact that organizational competencies are based on the effective and efficient management of knowledge assets puts it at the heart of business performance and value creation. According to Rumizen (2002), knowledge management is a work in progress and its benefits can be lost if not managed carefully. The focus is not so much on the information technology but on the process required to generate, capture, use and maintain content. KM can be managed only after it has been created. He represented his views in the diagram below.

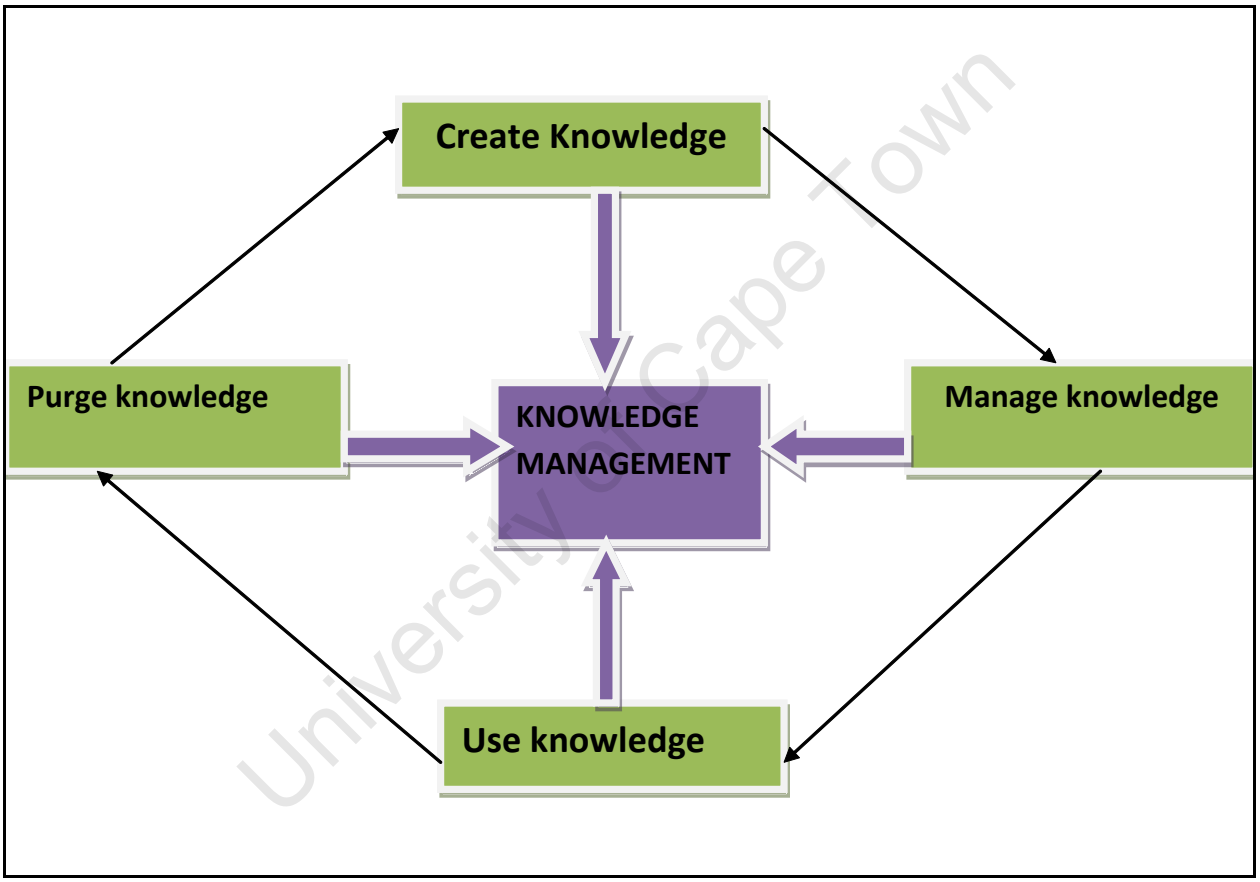

FIGURE 3- 1: Adaption of Rumizen's (2002) diagram depicting the four aspects of KM.

3.3.3 Knowledge Management: Strategy and Leadership

The implementation of a KM effort requires an organizational strategy that is based on contributions by various members of the organization (Yeh *et al*., 2006:795). Deriving from the

organization's strategy are the various organizational policies and programmes. These policies and programmes must be aligned with each other and should be mutually supportive of an organization's KM strategy (McElroy, 2003:60). Related to a KM strategy is the concept of leadership. The implementation of a KM effort requires adequate support and dedication from top management (i.e. the organization's leadership) as this influences how resources and time are allocated for executing the KM plan (Yeh et al., 2006:797). A successful KM strategy therefore runs parallel with exemplary leadership that values 'trial and error' and shows a commitment to innovation and continuous improvement (McElroy, 2003). An effective KM strategy thus requires: long-term commitment from all organizational members, (2) the ability to be receptive to changes in both the internal and the external organizational environment and (3) leadership that demonstrates an enthusiasm for improvement. Furthermore, an effective KM strategy must take advantage of knowledge-enabling technological developments to allow the organization to be more responsive in terms of service provision and developing relationships (Skyrme, 1999:33).

3.3.4 The Competitive Advantage of Knowledge Management

It is argued that innovation, not just efficiency or quality, is the primary source of competitive advantage and further that knowledge is central to an organization's capacity to innovate. Leonard-Barton (1995: 8) says knowledge building for an organization occurs by combining peoples distinct individualities with a particular set of activities. Knowledge and innovation have therefore been seen to replace efficiency and quality as the main sources of competitive advantage for organizations. Knowledge management is about the ability to harness and use an organization's knowledge for competitive advantage. It is also about the ability of an organization to learn from itself, its mistakes, its inefficiency and its employees. Managers must identify gaps between what knowledge they have and what they need to have if they are going to create an appropriate organizational structure that will assist with implementing a KM strategy.

Hardin (2002) has suggested that an important factor that promotes competitive advantage in an organization is if idea generation, differentiation and constant realignment to changes in the environment are stimulated. He further emphasizes the need to encourage the seamless flow of new ideas throughout the organization and the capability to adapt to change.

3.3.5 Relationship between Knowledge Management, Culture and Trust

- **Culture**: It is imperative to pay attention to the culture of the organization before KM practices can be implemented. The organizational culture refers to the unique combination of values, beliefs and models of behavior in an organization. It represents the organization's core values that dictate the behavioral norms of employees (Yeh et al., 2006:797). Thus, the manner in which people within an organization relate to each other, especially in a group and a team situation, is important in the KM process (Coakes et al., 2004:120). Organizational culture is closely integrated with an organization's collective tacit knowledge, it is an attribute which cannot easily be taught or transferred, making it a very difficult process (Taylor, 2007:30). Organizational culture further epitomizes both the significance and the advantages of organizational knowledge and its impact on employees' willingness to share their knowledge and provide it as valuable input into the organization (Yeh et al., 2006:797). According to Skyrme (1999:184) "an organizational culture that fosters knowledge sharing and enhancement, displays the following characteristics:
    - A transparent organizational milieu
    - An empowered workforce
    - A dynamic learning environment
    - A continual quest for novel means of development and innovation
    - Concentrated, transparent and extensive communication
    - Periods of reflection, learning and experimentation
    - Communication and interaction across and within groups

- Objectives and performance gauges that are synchronized across the organization
- An inclination toward extensive knowledge sharing among individuals who make up the workforce".

The effectiveness of KM in the organization is restricted if an organization has an all-inclusive KM system in place but does not have a supportive organizational culture. Thus, the real value and meaning of knowledge within an organization only becomes apparent when it is viewed in the context of organizational culture and trust (Coakes et al., 2004).

- **Trust**: Casson (1997) defines trust as a warranted belief where a person will honour their obligations, not merely because of material incentives, but out of moral commitment to do so. It is assumed that such moral commitment is rational because it generates emotional rewards. The presence of a relationship of trust between individuals indicates an ability to share a high degree of mutual understanding that is built upon a common appreciation of a shared social and cultural context. Both trust and mutual understanding, developed in their social and cultural contexts, are prerequisites for the successful transfer of tacit knowledge.

Dodgson (1993) argue that the basis for any effective collaborative work practice is the development of high trust relationships between related parties - only in this way can the exchange of knowledge be truly effective. Employees seek a strong series of cultural values, e.g.: Open and honest communication, fairness and respect, optimum working conditions, innovativeness, the acceptability of mistakes, a friendly environment, training and development opportunities (Casson, 1997).

Trust can be seen as maintaining reciprocal faith in each other in terms of intention and behaviors. Trust may facilitate open, substantive and influential knowledge. Trust is also critical in a cross-functional or interorganizational team because withholding information because of a

lack of trust can be especially harmful to knowledge creation. Therefore, creating trust in the organizational context is a key aspect of effective knowledge management practice. It is proposed that if authority in an organization is exercised in a legitimate fashion, then trust will more naturally follow from this. If trust exists, then power resources will be used to further organizational goals, rather than individual goals, and as knowledge is a power resource, knowledge flows will thus be greatly enhanced and improved. Yeh et al. (2006), suggests that knowledge flows are totally dependent on the levels of trust which exist within any organization. This should be constantly reinforced and adjusted by means of effective communication and a clear indication of expectations that is backed up by reward systems as well as sanction systems. In order to emphasize the link between knowledge management and trust, the following three schools of thoughts relating to knowledge will briefly be examined:

- Cognitivism
- Connectionism
- Autopoeisis

A cognitivist epistemology approach refers to ideas that the mind has; the ability to represent reality in various ways, i.e. creating inner representations that partly or fully correspond to reality. The connectionist approach to knowledge argues that knowledge emerges and resides not only in the brains of each individual, but also in the connections among members through the roles of meaningful interrelationships. Here trust in relation to a group mindset and collective action is an important issue – it consists of an emotional bond participating parties in a relationship. And lastly, the autopoietic approach is based on the work of Yeh et al.(2006), and relates to the concept of a living system i.e. it suggests that cognition is a creative act of bringing forth the world. It sees knowledge as a component of the autopietic (self – productive) process, as history dependent and context sensitive. They further propose two preconditions to enable knowledge to connect in the organization over time - firstly, the availability of relationships and secondly, the organization should compose a “self-description”, i.e. an outline of its identity. Relationships among members of an organization lead to communication which in turn allows knowledge to develop. Trust is essential because it provides an open system

necessary for knowledge development and the autopietic process enables trust to develop by means of an adequate self-description.

3.3.6 Organizational Structure and Knowledge

Organizational structure may be defined as the manner in which individuals and posts are organized to make the performance of the organization's work possible (Syed-Ikhsan and Rowland, 2004b:101). Nonaka (1994:30) argues that a top-down bureaucratic structure is not conducive to the process of creating knowledge within an organization, as only top management have the power and ability to create knowledge. Conversely, in a bottom up organizational model only lower-level and middle-level employees are responsible for knowledge creation, which is also not favourable. What is required, however, is a model that takes into account all organizational members who work together collectively to generate knowledge. This means that no particular department or group has the sole responsibility for knowledge generation. The organizational structure must therefore promote communication across and within organizational boundaries and strengthen interdependence of teams and networks (Skyrme, 1999:185). Thus it is imperative that when an organization embarks on a KM strategy, it realigns its organizational structure to facilitate the creation and effective flow of knowledge throughout the organization.

3.3.7 Knowledge Management and Human Resources

Knowledge is derived from an individual's use of information combined with that person's experiences. This combination is what makes individual knowledge valuable for organizations and society at large (Syed-Ikhsan and Rowland, 2004a:238). As a result, an organization's human resources have a big impact on the organization's KM activities. In modern society the importance of the knowledge worker is central to any knowledge activity. According to Sutton (2006) the knowledge worker performs work that involves the generation of constructive information and knowledge by means of accessing, making sense of and using (1) data and information; (2) personal knowledge; (3) external knowledge and information; and (4) organizational knowledge (. Knowledge workers are required to consistently utilize and convert

knowledge from various sources to facilitate decision making and maintain adequate standards within the business processes (Taylor, 2007:39).

The contributions of knowledge workers who are prepared to build a culture conducive to KM by sharing knowledge, generating new knowledge, networking and participating in knowledge-based activities is vital to effectively execute a KM effort in an organization (Sutton 2006). It is thus necessary to take into account various components of the human resources function when considering its influence on KM within organizations. During the recruitment process, most organizations specify and assess an employee's expected level of knowledge. However, employee knowledge and skills only hold value for the organization once they are effectively applied to the employee's new position within the organization (Taylor, 2007:32). Syed-Ikhsan and Rowland (2004:103) identify posting, training and staff-turnover as key criteria to consider in this regard. In terms of posting, Syed-Ikhsan and Rowland (2004b:103) argue that employees' past experiences, skills and qualifications are valuable to an organization and when employees are placed in the right position within an organization, it is to be expected that new knowledge will be generated effortlessly. Despite existing employee knowledge and skill, employees should be given the opportunity to gain valuable new knowledge from induction and training programmes (Taylor, 2007:33). Adequate training further enables employees to transfer their knowledge into the organization's practices, processes, policies and traditions (Syed-Ikhsan & Rowland, 2004:103). Training and learning programmes thus make favorable contributions to an organization's human capital in the long run (Taylor, 2007:34). High staff turnover also poses problems for KM in that vital organizational knowledge may be lost when this occurs.

3.3.8 The Relationship between Information Technology (IT) and Knowledge Management

Information technology is central to the maintenance and organisation of KM efforts (Yeh et al. 2006:799). According to Yeh et al. (2006:799) information technology supports KM by facilitating quick searching, access to and retrieval of information, which in turn encourages

cooperation and communication between members of an organisation. Various information technology tools are available to organisations to aid effective KM (Syed-Ikhsan & Rowland, 2004b:102). The groups of information technology tools that are utilized for the purpose of KM are often referred to as KM systems (Alavi and Leidner, 2001:114). When an organisation considers employing a specific IT tool for KM it is necessary to do an analysis of the organisation and its current systems in order to determine which tool would be the most effective in facilitating the organisation's KM requirements (Taylor, 2007:60). It is also important to know how the tool will be integrated with current IT or KM systems and what degree of staff training and development would be required upon implementation of the tool (Taylor, 2007:60). Only when the worth of the tool is established and its value is explicitly recognised, and then is it likely that it will be successfully utilized (Taylor, 2007:61).

3.3.9 Knowledge Management and Communication

Communication is widely recognized as a critical factor to the successful implementation of any change in an organization.

> "***You are responsible not only for what you say, but also for what you do not say "(Martin Luther).***

The need for communication has been defined as a process by which individuals share meaning. It offers the means of creating and implementing behavioural changes both within and without an organization in an intra-organizational context. It has been suggested by Hislop (2002) that the appropriate framework within which to conceptualize and manage internal communications consists of three components that have to be integrated to ensure an effective system of internal communication, viz.:

- the atmosphere for communication
- the communications process
- communication methods.

Thus to be effective in communicating with employees, organizations need to ensure that a culture of communication pervades the entire organization. Such a culture should encourage horizontal and vertical communication as well the seamless flow of information across the

organization. Moreover, for effective communication to take place a balance needs to be struck between the need to communicate formally and the facilitation of other informal and usually more personal forms of communication. Enlightened organizations, according to Hislop (2002), have expended extensive effort in facilitating a "bottom up" communication strategy through the use of tools such as questionnaires, suggestion boxes and hotlines. This allows senior managers to tap into the expertise of their staff at all levels within the organization. A unified and continuous pattern of communication with employees that seeks to establish relationships within and across traditional departmental and hierarchical boundaries will greatly facilitate the absorption of institutional priorities and values. It will, moreover, allow employees to make individual contributions to the overall benefit of organization. (Hislop, 2002).

Hardin (2002) has suggested that an important factor to ensure successful communication is the "listening aspect". Listening provides an opportunity to understand what the other person has heard and perceived. This is especially critical when a message (e.g. the corporate strategy) is passed through many layers of the organization with each layer filtering and possibly changing the information before passing it on to the next.

Communication can further be effectively used as a strategic tool to coherently and proactively handle change. A well-planned communications strategy can assist in reducing the discomfort of change and legitimize the change management process by clearly indicating how it is aligned to the organization's goals and future direction. By clearly communicating the envisaged changes to all employees, management will instill stronger confidence in its new programs, decisions and activities, as well as in the organization's sustainability and capability. It not only informs, but also empowers all employees and stakeholders to understand the change and transformation that the organization is undergoing. In fact, the more stakeholders hear and learn about why and how an organization is moving in a particular direction, the fewer conflicts there will be. (Hardin, 2002).

The researcher suggests that an effective means of communication in an organization would be by creating online social networking platforms and communities of practice.

3.3.10 Online Social Networking (OSN) and Communities of Practice (CoP)

Productivity can be described as the time spent by an employee actively executing the job he or she was hired to do, i.e. to produce the desired outcomes expected from the employees' job description. Productivity thus refers to how well an individual performs. Research by Hislop (2002) show that the performance of individual top performers is not only related to their own performance, but also to the quality and frequency of interaction with colleagues in the organization. Thus, in an organisational context, value can be found by not only attracting and developing individuals who hold specialised knowledge, but also by promoting and encouraging participation in social networks that enable the sharing of knowledge. Lesser and Storck (2001:832) and Bartlett and Ghoshal (2002:38) have further suggested that by connecting such individuals the establishment of a community of practice (CoP) is facilitated. Such a CoP allows and encourages members to engage in sharing and learning based on their common interests. To this Khanna and New (2008:795) and Hong, Kianto and Kyläheiko (2008:196-202) add the importance of the optimal use of the social Web and online social networks (OSN) to enhance knowledge work and exchange in an organisation that is culture and generation diverse. Such interaction increases employee satisfaction and fosters individual and organisational performance. They however, also warn against the risks associated with OSN.

Although the concept of community of practice (CoP) is relatively new, the phenomenon it refers to dates back to ancient times. Wenger, probably the most prolific author in this field defines the concept as being “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (Wenger, 2006:1). It has also been defined by Wenger (2006) as a “flexible group of professionals, informally bound by common interests, who interact through interdependent tasks guided by a common purpose thereby embodying a store of common knowledge”. In recent years, significant effort has been

devoted to understanding and emphasizing the role of knowledge in conferring competitive advantage. Central to this is the notion of "a fundamental shift in the corporate value system, away from physical and financial assets towards the creative exploitation of a nexus of intangible assets, quasi-assets and competences mainly in the form of distinctive capabilities deriving from knowledge intangibles" (Khanna and New, 2008). Knowledge management is therefore seen as the process of managing the intellectual capital of an organization

Social networking tools are used both consciously and unconsciously. Employees often use ONS as an immediate knowledge-sharing discussion in an unconscious manner and will consciously use it to request information that they need, for instance, in locating subject matter experts or working and collaborating on projects, often on a global level.

3.3.11 Organizational Learning and Knowledge

Organizational learning is an increase of the organizational knowledge base which leads to the enhancement of the problem-solving potential of a company (Garvin, 1994)

Organizational learning is not an individual activity, but rather relates to communal effort that requires much work and an all hands on deck approach (Garvin, 1994). According to Garvin (1994) organizations that engage in organisational learning have to know what they want to be and what resources they have to achieve such an organizational strategy. Management then needs to share its organizational learning strategy with employees (communicate); define progress and success (measurements); look for gaps between current reality and future reality (feedback); and finally strive to narrow the human resource gaps (hire, train and develop). Ultimately, all of these activities become interdependent. The following quote illuminates this point:

"Give a man a fish and you feed him for a day. Teach him how to fish and you feed him for a lifetime" (Lao Tsu).

In organizational learning it is further imperative that managers realize three things:

- a single training plan for the entire organization or one that is permanent is not tenable;
- the tools that today's managers were trained under are out of date;
- an organization must evaluate how it learns and how well it supports learning.

According to Gavin (1994), training programmes to enhance organizational learning must be designed to help close the gaps between an organization's current reality and its future transformation. Managers must develop training programmes that suit many different needs and this implies that different people will need different skills at different times. Managers will have to develop people with the capability to train others, transfer knowledge, use current technology and prepare for their next job. Training and development has also become a way to retain employees who are interested in personal growth and challenges, an incentive equal to salary. A further factor is that employees that possess the values that an organization particularly wants to have, will have to be protected against obsolescence and retrained before their skills are outdated. (Gavin, 1994).

There are numerous of tools that can be used to train employees and facilitate learning, e.g. The greatest problem is not in finding an appropriate tool, but in losing focus of the outcome, e.g. such tools can absorb considerable organizational energy, and employees can get distracted just using the tools. The Internet is a good example of how often people have logged on to search for information and become so fascinated by the tool that their search loses its original meaning.

Tools that can be used for this purpose include:

- Data warehousing, data marts and data mining which provide the capabilities to let organizations create knowledge out of data by combining various databases into one and then using mining tools to spot trends and extract hard-to-get data.
- Groupware, usually run on intranets, can provide platform-independent knowledge sharing. (Gavin, 1994).

- Intranets leverage an organization's intelligence by allowing users to easily create access and distribute organizational information (Gavin, 1994).

Appelbaum and Reichart (1998) thus suggest that the evaluation of an organization's ability to learn will facilitate the development of a learning organization. The identification of obstacles to learning (usually a part of an organization's culture) is thus a necessary first step to implementing a learning culture. Organizations that are unaware of, or in denial about, these mental blocks will not have a high success rate. According to Appelbaum and Reichart (1998) organizational learning should therefore focus on the importance of

- acquiring, improving and transferring knowledge
- facilitating and making use of individual learning; and
- modifying behavior and practices to reflect the learning.

It is obvious that the tools to support training are available and are as sophisticated and simple as the organization they are designed to support. The challenge is in encouraging employees to learn faster and then to bring that information back to the organization and train others. As well as ensuring that what employees learn supports the business plan of the organization, such training should also enhance efficiency.

3.4 Innovation and Knowledge Management

Drucker (1985) defines innovation as "exploiting change as an opportunity" and such opportunities are to be found everywhere in the rapidly changing environment in which all businesses now compete. Drucker also made the famous distinction between efficiency "doing things right" and effectiveness "doing the right things". The distinction is important as efficiency is essentially about reducing cost while effectiveness is about innovation. The unique tacit knowledge of individuals is of immense value to the organization as a whole, and is the "wellspring of innovation". Innovation can be viewed as an inter-linked process starting with idea generation and progressing to idea exploitation and which is not contained within specific boundaries and is always subject to change (Nonaka and Takeuchi, 1995). There is now a

general acceptance in competitive business environments and project based industries that knowledge is a vital organizational and project resource that gives market leverage and contributes to organizational innovations and project success (Egbu, 2000). Again it could also be argued that an organization's capacity to innovate depends to a very considerable extent upon the knowledge and expertise possessed by its staff.

Effective Knowledge Management has parallels with effective innovation. For innovation to take place, an organization needs caring people who are willing to share for the greater good of the organization and creative people who have the ability to turn ideas into practical products and services. For an organization to be successful in innovation, it needs vision (what it wants to be), foresight (a knowledge of where the world is going), an understanding of its core competencies (which will assist in setting Knowledge Management priorities), freedom for employees to achieve those goals, and an atmosphere which enables and encourages people to give help and draw help from others. Egbu (2000), is of the opinion that innovation is a result of an existing link between knowledge management and enhanced economic performance. "Innovation is high on the minds of executives around the world; it is seen as the main reason for the pace of change in the global business environment" (Egdu, 2000). Various schools of thought have suggested that innovativeness could be treated as being composed of:

- a technological dimension and
- a behavioral dimension

This refers to the capacity and the commitment of the organization to innovate. The technological dimension can generally be seen to refer to the machinery and equipment used for production; i.e. its technology history and as such it defines the capabilities, constraints and opportunities of the organization in exploiting technological innovations. The behavioral dimension of an organization can be seen as the sustained behavioral change of the organization and more specifically relates to the attitude of the organization's managers towards the adoption and installation of important technological innovations.

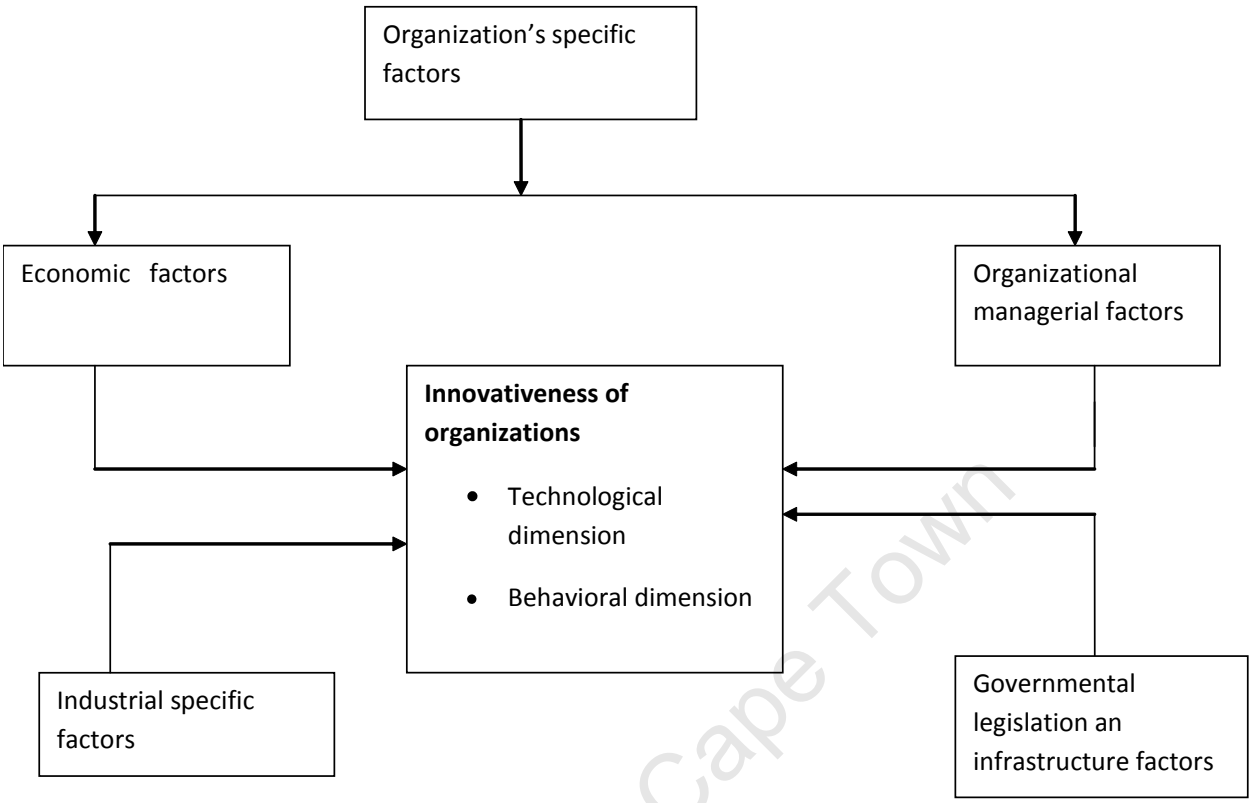

FIGURE: 3-2 A conceptual model of innovation adapted from Avlonitis, G et al., 1994

3.4.1 The Impact of Knowledge Management on Innovation

Knowledge and knowledge management fulfils numerous functions in the innovation process. The first major role that knowledge management plays in innovation is enabling the sharing and codification of tacit knowledge. Tacit knowledge sharing is critical for organizations' innovation capability (Cavusgil et al, 2003). Organizations that have a high innovation potential adopt a learning-by-doing method of working and this makes it difficult for competitors to buy this know-how in the market and also makes it difficult to replicate. According to Cardinal et al. (2001), two factors make the replication of knowledge-based competitive advantage very difficult. "Causal ambiguity" firstly results in specific practices or inputs (e.g. knowledge) being unknown and thus prevents replication. Secondly, social complexity or a unique organizational history makes it difficult to replicate the knowledge that has been produced. Getting tacit knowledge from customers and suppliers is therefore a valuable source of innovation and input

into an innovation programme. Again, collaboration between organizations plays a significant role in sharing of tacit knowledge, which in turn positively impacts innovation capability (Cavusgil et al, 2003).

The sharing of tacit knowledge as resource for innovation is especially important in developing fields where not a lot of explicit knowledge exists, such as biotechnology. Innovators in these fields combine partially codified knowledge with complementary resources such as cross-functional teams or learning-by-doing capabilities, which leads to new product and process innovations (Cardinal et al., 2001). Cardinal et al. (2001) indicate that, in situations where a lot of tacit knowledge is used for innovation, collaboration between cross-functional teams is essential. Such interactions produce the routines that create new ideas. However, the knowledge in these ideas is not necessarily codified, but often remains contained within the innovation and operational teams' space.

The second major role that knowledge management plays in the innovation process is related to explicit knowledge. Although explicit knowledge does not play such a dominant role as tacit knowledge in the innovation process due to the fact that explicit knowledge about innovations is easily accessible to competitors, explicit knowledge is also an important component of innovation. In developed science processes, explicit knowledge features strongly in the research and development process with a rich exchange with tacit knowledge taking place. This process requires the capability to convert tacit and explicit product and process knowledge into explicit models. "Whilst the knowledge from upstream research and development discoveries are usually tacit in nature, knowledge downstream in the value chain is largely explicit and codifiable in nature" (Cardinal et al., 2001). It is therefore important for organizations to build resources and capabilities that will allow them to capture and codify knowledge and product development routines, to ensure that knowledge transfer can take place adequately (Scarbrough, 2003).

The third major role that knowledge management plays in innovation is through the enabling of collaboration. Collaboration could be defined as the ability of customers and employees to form knowledge sharing communities within and across organizational boundaries, that can work together to achieve a shared business objective, resulting in benefits to all community members. Collaboration, both internal and external to the organization, plays an especially significant role in transfer of tacit knowledge and building collective know-how (Cavusgil et al., 2003; Pyka, 2002; Rodan, 2002; Scarbrough, 2003). The stronger the relationship between collaboration partners, the greater the extent of the tacit knowledge transfer (Cavusgil et al., 2003; Scarbrough, 2003). Gathering tacit knowledge from collaboration partners could potentially reduce risk and cost in innovation by ensuring a 'first-time-right' approach, thus shortening development cycles and ensuring effective innovation (Cavusgil et al., 2003).

Knowledge management can facilitate collaboration as mechanism to foster innovation through provision of technological platforms and tools to enable knowledge sharing within knowledge sharing communities, such as online discussion forums. It also fosters non-technical platforms or mechanisms for collaboration, such as competency groups or communities of practice. Knowledge management also provides the processes to ensure knowledge creation, sharing, gathering and leverage within these collaborative forums. Seeing that tacit knowledge is such an essential element in the innovation process, knowledge management clearly plays a crucial role in ensuring the sharing of tacit knowledge in collaborative environments, but also its codification into explicit formats to enable re-use in different contexts.

The fourth role that knowledge management plays in the innovation process is managing various activities in the knowledge management lifecycle, which consists of the phases of creation, gathering, sharing, and leveraging of knowledge. Knowledge management plays a significant role in ensuring the integration of knowledge in the organization through provision of structure and organizational context, and this in turn facilitates knowledge sharing and leveraging. According to Chen (2009), knowledge integration implies that individual insights can be made generally available and used at the right time to assist with sense making, i.e.

knowledge can be exchanged, shared, evolved, refined and made available at the point of need. Effective knowledge management that underpins knowledge integration ensures that the organization efficiently and effectively utilizes its knowledge as a resource for innovation (Baddi and Sharif, 2003)

The fifth role that knowledge management plays in the innovation environment is through the creation of a culture conducive for knowledge creation and sharing as well as collaboration. Several researchers have emphasized the pivotal role of the management of knowledge, particularly in creating an internal working environment that supports creativity and fosters innovation (Gloet and Terziovski, 2004). Gloet and Terziovski (2004) have also concluded that organizations should strive for an integrated approach towards knowledge management which assists in building a corporate culture in order to maximize innovation performance leading to competitive advantage. According to Scarbrough (2003) knowledge management's cultural contribution to innovation lies in its overlap with human resource management, e.g. issues such as competence building.

Knowledge creation, sharing and leverage build employee skills that are particularly relevant to the innovation process. Particular skills are required in specific innovation settings, and knowledge management can ensure that those individuals with the most appropriate skills sets are selected to assist in the innovation process. Knowledge management also contributes to creation of a culture conducive to innovation through the way that knowledge creation and sharing behavior is measured and rewarded.

3.4.2 Creating an Innovative Culture

Organizations should learn to inspire their employees to new levels of inventiveness in everything that they do, not just in marketing or new product development. Much can be done by most organizations to boost their overall innovation. It starts with learning to tap into the creative potential of all the employees and their knowledge about customers, competitors, and processes, and the key is to establish the right organizational climate. Beyond this,

organizations also need to learn how to attract more diverse and unconventional talent. Turning ideas into commercial reality requires persistence and discipline, and overall effectiveness and this ultimately depends on top management being able to find the right balance between corporate creativity and efficiency. Koudal and Coleman, (2005) list the following factors that to ensure a successful innovative cultural environment:

- Support from top management and the presence of a strong innovation champion
- Flexibility in the lines of communications allowing top-down, bottom-up and lateral communications within organizations
- A risk tolerant climate, where it is accepted that lessons could be learned through mistakes
- A climate where people genuinely feel valued and people feel some form of ownership or involvement with the innovation
- A sharing culture where there is openness and willingness to share information, experience and knowledge across project teams and the organization
- A climate where people feel secure in their jobs.

All these factors are key to the development of an internal climate where individual creativity and initiative can flourish, and talent and ideas circulate freely, so that intellectual capital can be leveraged to the maximum. In summary these factors are dependent on an environment where according to Peter Drucker; there is ‘‘organized, systematic, rational work in which everyone who face up to decision making can learn to be entrepreneurial”. Andrew Hargadon and Robert Sutton in turn argue that innovation has ‘‘everything to do with organization and attitude’’ and very little to do with nurturing genius. Innovation depends on ideas, and the primary source of ideas is talented individuals. (Davenport et al., 2003)

3.4.3 Role of Intellectual Capital (IC) or Human Capital

Intellectual capital is the pursuit of effective use of knowledge (the finished product) as opposed to information (the raw material) (Bontis, 1998). Stewart (1997) is of the opinion that IC is knowledge, information, and experience that can be put to use to create wealth and it is

the collective brainpower packaged as useful knowledge**.** It is important for employers to determine how to capture human capital and convert it into structural capital so that it is not lost in times of rapid restructuring and high staff turnover. The recognition that people are a valuable asset to organizations is not new. Smith wrote that "education was to be viewed as an investment in human beings and advocated higher wages for skilled workers". By the 20th century psychological theories of the behaviour of individuals in the workplace had become popular, and the sub-discipline of organizational behavior was born (Stewart, 1997). The focus of this school of thought was at a far more micro-level than previously, and involved studies of personality, leadership, motivation, attitudes and group behaviour (Howell and Dipboye, 1986). This has dominated much of the thinking about the value of people within organizations of the knowledge management era. It has been argued that the key to the process is to focus on how employers capture the human capital in their organizations and convert it into structural capital to promote:

- knowledge generation
- knowledge exchange and
- knowledge retention.

Edvinsson, the person behind Skandia's IC initiatives, developed a dynamic and holistic IC reporting model called the Navigator with five areas of focus: financial, customer, process, renewal and development and human capital. This new accounting approach sought to identify the roots of a company's value by measuring hidden dynamic factors that underlie 'the visible company of buildings and products' (Edvinsson and Malone 1997: 11). Intellectual capital thus consists of three broad classification categories:

- Human capital: Sanchez et al. (2007) defines it as the knowledge that employees take with them when they leave the organization at the end of the day. People are the source of ideas, inspiration and innovation in every organization. Their knowledge, competencies and experience become part of the organization's capital until they leave or until it becomes part of the shared knowledge of the organization. Similarly, Lynn

(2000) defines it as “an inventory of the skill sets and knowledge of individuals within an organization”.

- Structural capital, sometimes referred to as organizational capital, includes intangible assets such as information systems, distribution networks, strategy for work team creation and maintenance, competitive market intelligence, and knowledge of structures, systems and the market (Lynn, 2000). To complement the definition of human capital, structural capital can be seen to be the “knowledge that doesn’t go home at night. It belongs to the organization and can be reproduced and shared. ” (Stewart, 1997: 108-109).
- Relational capital refers to the value of an organization’s external relationships with the organizations and people with whom it does business; that is its stakeholders and customers. Sveiby (1997) defines this type of external capital as the network with external stakeholders who have a key influence on the organization. Among recent models of intellectual capital are the Balanced Scorecard (Kaplan and Norton, 2001), the Skandia Navigator (Edvinsson, 1997), the Intangible Asset Monitor (Sveiby, 2001) and the Value Platform (Brennan and Connell, 2000).

Kaplan and Norton’s Balanced Scorecard framework focuses not only on the capabilities and productivity of employees but also on employee satisfaction and retention. Edvinsson and Malone’s Skandia Navigator (Edvinsson and Malone,1997) measures an organization’s human capital in terms of percentage of graduates; annual turnover of staff; average years of service with the company; and a leadership index that measures the proportion of leaders within an organization. Similarly, Sveiby’s (2001) Intangible Asset Monitor measures staff education levels, training and education costs, professional turnover, and proportion of professionals to support staff, average age, seniority, and relative pay positions. Guthrie and Petty’s Modified Intangible Assets Monitor (Brennan and Connell, 2000) aimed to measure employee know-how, education, vocational qualifications, work-related knowledge, work-related competencies, entrepreneurial spirit, innovations, proactive and reactive abilities, and changeability.

Sveiby (1988; 1997)	The Intangible Asset Monitor	Internal structure External structure Competence of personnel
Kaplan and Norton(1992)	The Balanced Scorecard- Internal processes perspective	Customer perspective Learning and growth perspective Financial perspective
	Classification of Resource Classification of Resources	Competence Relational Competence Rational
Edvinsson and Malone (1997)	Skandia Value Scheme Human capital	Structural capital Human capital

Table 3- 1: A Framework for classifying intellectual capital (adapted from Guthrie, J: 2001)

3.6 Concluding Remarks

Managers and academics have recognized knowledge as a key source of competitive advantage (Grant, 1997). Knowledge is a potentially significant resource to the organization as it may possess valuable, rare, inimitable and non-substitutable characteristics particularly if it has a tacit dimension (Hall and Sapsed, 2005). The ever increasing importance of knowledge in contemporary society calls for a shift in our thinking concerning innovation in research organizations, be it technical innovation, product or process innovation, strategic or organizational innovation. It raises questions about how organizations create new knowledge and, more importantly, how they transfer new knowledge. Innovation, which is a key form of organizational knowledge creation, cannot be sufficiently explained in terms of information processing or problem solving.

Innovation can be better understood as a process in which the organization creates and defines problems and then actively develops new knowledge to solve them (Nonaka, 1994: 14). Davenport and Marchand (1999: 2) suggest that: ‘‘whilst knowledge management does involve information management, beyond that it has two distinctive tasks: to facilitate the creation of new knowledge and to manage the way people share and apply it’’. In Nonaka et al.’s (2000) unified model of knowledge creation, knowledge is described as dynamic, since it is created in social interactions amongst individuals and organizations. Knowledge is context specific, as it depends on a particular time and space. Without being put into context, it is just information, not knowledge. Information becomes knowledge when it is interpreted by individuals and given a context and anchored in the beliefs and commitments of individuals (Nonaka et al., 2000). This view of knowledge is also shared by Davenport et al. (1998: 43). It has further been suggested that knowledge that is new to an organization has to either be invented internally, or acquired from external sources. Nonaka et al. (2000) identify seven processes to manage knowledge assets:

- knowledge generation;
- knowledge codification;
- knowledge application;
- knowledge storing;
- knowledge mapping;
- knowledge sharing; and
- knowledge transfer.

These processes are based on an understanding that knowledge is dynamic in nature, and on this basis they provide guidelines of how to use, transfer, share, develop, and renovate the knowledge assets of an organization (Wiig, 1997).

KM and IC management is dependent on managerial understanding of these factors and how they relate to the bigger picture. A good internal structure, expressed through the strategies,

processes and culture of an organization, is one that is flexible but supportive of the ideas propounded by employees. The organizational structure should respond just as effectively to external pressures. For example, Davenport and Marchand (1999), claims that hierarchical structures become deficient in turbulent environments. In contrast, structures determined by core competencies can adapt to chaotic external pressures more easily. Such competencies should be flexible to meet new customer demands or expectations (Nonaka et al.2000). Byrne (2001) asserts that excessive bureaucracy can stifle innovation because of, for example, the amount of time it takes to approve every idea. Bureaucracy can inhibit spontaneity and experimentation and thus threaten the innovation process. It was however asserted that flexible structures encourage better internal communications and a more change friendly climate where ideas and knowledge are shared freely. In addition, it has been suggested that there is a need to establish relationship between people and the structures of an organization, between individual knowledge and organizational knowledge (Bryn, 2001). Employees must be sufficiently motivated to share knowledge, through incentives.

Byrne (2001) argues that the organizational structure should play a part in the encouragement of knowledge sharing. He contends that motivation is a key facilitator of loyalty and trust amongst employees and eventually fosters continuous learning. Further theories about organizational culture favour the evolution of a community of practice where social interaction of employees cultivates a knowledge sharing culture based on shared interests, thus encouraging idea generation and innovation Leadership is an inherent part of organizational culture, and leadership is an organizational responsibility. Emphasis should be placed on the value of institutional leadership, to create the structures, strategies and systems that facilitate innovation and organizational learning. Many organizations employ information technology (IT) in one form or another to manage their knowledge. It is primarily used to store and transfer explicit forms of knowledge. However, IT is not just about computers. Tools such as video-conferencing may also be useful for the transmission of tacit knowledge as it is, in crude terms, a form of socialization (Nonaka and Takeuchi, 1995). Capturing tacit knowledge and then storing it in repositories is vital for effective KM. Many organizations have developed

sophisticated methods for storing their IC, including patenting knowledge assets to protect trade secrets. Edvinsson (2000) contends that such tools such as the Internet are merely enablers and that the true asset of an organization is the brainpower of its workforce. He stresses that it is the IC of an organization that is the key to success (Edvinsson, 2000). Thus, KM is not just about databases or information repositories.

"In computer systems the weakest link has always been between the machine and humans because this bridge spans a space that begins with the physical and ends with the cognitive" (McCampbell et al., 1999: 174).

4.0 CHAPTER FOUR: THEORETICAL FRAMEWORK

"A framework is a holistic and concise description of the major elements, concepts and principles of a domain. It aims to explain a domain and define a standardized schema of its core content as a reference for future design implementations. A KM framework explains the world of KM by naming the major KM elements, their relationships and the principles of how these elements interact. It provides the reference for decisions about the implementation and application of KM". (Weber et al., 2002)

4.1 Introduction

Many scholars and practitioners today have agreed that the capability to create and utilize knowledge is considered to be the most important source of an organization's sustainable competitive advantage. Instead of merely solving problems, organizations create and define problems, develop and apply knowledge to solve the problems, and then further develop new knowledge through the action of problem solving. The organization and individuals grow through such a process. The organization is thus not merely an information processing machine, but an entity that creates knowledge through action and interaction (Nonaka et al., 2000b)

As mentioned in chapter 1, this study aims to investigate how knowledge is managed and shared within CSIR and with other stakeholders. Attention is paid to how the explicit knowledge that exists in the organization (i.e. the knowledge that can be easily documented and shared), as well as the tacit knowledge that is embedded in employee's minds is captured, organized, stored and retrieved when needed by organizational members. The study also sought to discover the kind of managerial and hierarchal challenges that serve as barriers to innovation and the free flow of knowledge and then further to suggest solutions to such problems and challenges. The important role that information and communication technologies play in knowledge management further prompted the researcher to investigate the status of ICTs in the CSIR and its capacity to support organizational knowledge management.

This chapter thus outlines the theoretical framework for the study. It reviews the conceptual background in the discipline of knowledge management and discusses models and case studies and how these theories apply to organizational knowledge management.

4.2 Managing Knowledge in Organizations

Kluge et al (2001:191) is of the opinion that the question of how an organization manages its knowledge has no single answer and that it encompasses all sorts of issues that further vary for different kinds of organizations. The actual question is how can an organization systematically exploit all dimensions of knowledge and fully utilize them to improve effectiveness, innovation and growth. Due to the very nature of knowledge, it is difficult for management to predict what measures can really improve performance, and how to encourage and guide knowledge flows within an organization.

As was seen in Chapter 3.1 it is not easy to define the term 'knowledge'. Part of the difficulty perhaps lies in the distinction between data, information, and knowledge (Hislop, 2005; Mertins et al., 2001). Knowledge is generally understood to be authenticated information that has been assimilated into a coherent framework of understanding (Alavi and Leidner, 2001; Hislop, 2005) Castells (2000:17) further suggests that knowledge and information are critical elements in all modes of development and that the process of production is always based on some level of knowledge and the processing of information. The action of knowledge upon knowledge itself is a main source of productivity and in Castell's (2000:17) view, understanding can only be achieved when knowledge has been accumulated and acted upon. It is important therefore to manage knowledge for it is critical both for senior management and all other employees.

According to Nonaka and Toyama (2002), the knowledge-creating process is necessarily context-specific in terms of time, space, and relationship with others. Knowledge cannot be created in vacuum, and needs a place where information is given meaning through interpretation to become knowledge.

Knowledge is thus created through interaction between humans and social structures and according to Nonaka and Toyama (2002:6) our actions and interactions with the environment create and increase knowledge through the conversion process between tacit and explicit knowledge (cf. also section 4.2). Knowledge creation starts with socialization which is the

process of converting new tacit knowledge through shared experiences in day-to-day social interaction. Since tacit knowledge is difficult to formalize and is often space-specific, tacit knowledge can be acquired only through shared direct experience, such as spending time together or living in the same environment. A typically example would be a traditional apprenticeship where apprentices learn the tacit knowledge needed in their craft through hands-on experience (Nonaka and Toyama,2002). Nonaka and Toyama further suggest that incentive systems should be structured so that workers are motivated and rewarded for taking the time to generate new knowledge, share their knowledge, and help others outside their own divisions or functions.

According to Carneiro (2000), knowledge management can be regarded as an important precursor of innovation, that is ‘‘an idea, practice, or object that is perceived as new by an individual or other unit of adoption’’ (Rogers, 2003: 36). Innovation thus relates to the creation of new knowledge from the application of existing knowledge and has become a necessary tool for organizations wanting to remain competitive (Darroch and McNaughton, 2002). This requires concerted effort and a high degree of experience in recognizing, capturing and acquiring new knowledge, as well as improving on the use of existing knowledge.

In fact, KM in itself can be seen as an innovation. For example, organizations innovate on how best to manage their knowledge. These can be done through the two types of innovation, technological and organizational innovation. The first type, technological innovation relates to when, for example, an organization implements KM systems. This system is usually ICT-based systems which support the processes of knowledge creation, storage, distribution and application, also often known as KM systems (KMS). The second type of innovation is when an organization adopts innovations, be it the implementation of a new technology, method or practices.

Nonaka and Toyama (2002) have suggested that benchmarking and collaboration are two important processes that promote new knowledge generation and innovation. . An

organization, when it benchmarks, identifies outstanding best practices that are followed either by other organizations or within its own organization and then assesses how to improve a particular process with reference to the best practice. . Collaboration between individuals in turn brings together individual knowledge and this in turn often leads to the creation of new knowledge. This assumes that interaction between the individuals will promote learning. Collaboration between individuals is also the basis for Nonaka and Toyama's (2002) socialization of knowledge process. .

4.2 Selected Knowledge Management Models

The researcher investigated six knowledge management models to find a model that could best be adapted for this study. The first was Chase's model that is based on the '*Skandia Intellectual Capital model*'. The model assumes that intellectual capital (IC), an important factor in knowledge management, can be segregated into human, customer, process and growth elements which are contained in the two main categories of human capital and structural or organizational capital. Lank's (1997) account of the Skandia approach to KM is based on this model. He places strong emphasis on the measurement associated with each of these elements of IC assuming it can be tightly controlled, as is the case for tangible assets. The model takes a very scientific approach to knowledge and assumes it can be commoditized.

The second model that was considered was Gold, Malhotra and Segars' (2001) '*KM: organizational capabilities perspective model*'. The model describes knowledge as having been created through two generic processes, combination and exchange. The combination and exchange of knowledge that leads to the creation of new knowledge requires the presence of social capital. Social capital according to Gold, Malhotra and Segars (2001), is the "sum of actual and potential resources embedded within, available through, and derived from the network of relationships possessed by a social unit". According to Gold, Malhotra and Segars (2001) there are three key infrastructure factors that enable the maximization of social capital for effective KM; that is the structural, cultural and technological factors. The structural infrastructure refers to the presence of norms and trust mechanisms. Shared contexts comprise the cultural

dimension and the technological dimension addresses the technology-enabled ties that exist within the organization. In order to leverage infrastructure, knowledge management processes must also be present in order to store, transform, and transfer knowledge throughout the organization.

The third was Swan et al's (1999) model relating to the '*Roles of networks and knowledge management in interactive innovation'* and examines knowledge management in a networked environment. They investigated two different organizations to support their findings and stated that both cases attempted to introduce innovation in the provision and delivery of services to clients. In the case of Ebank, this was by means of the development of a global intranet and in the case of Brightco it was through the development of a common Enterprise Resources Planning (ERP) system. The Swan et al (1999), model confirms that interaction and knowledge sharing in organizations help to reduce 'reinventing the wheel'. In each of the cases the 'interactive innovation' model was used to investigate the role of information technology for KM. The Brightco case illustrated that the use of IT can provide an effective network to enable communication to facilitate KM in interactive innovation projects (Swan et al., 1999). It was seen that an active design and facilitation of social networking can provide the opportunity for individuals involved to develop overlapping, rather than mutually exclusive task-related knowledge and expertise. (Swan et al.,1999)

The fourth model that was examined was Nayır and Uzuncarsılı's '*cultural perspective on knowledge management model'.* The model's discussions were based on the success story of the Sarkuysan Company. It showed how the success of an organization can be attributed, among other factors, to its intelligent knowledge management practices. Knowledge is embedded in the social and cultural context (Nonaka, 1994). The model is an extension of Nonaka and Toyama's model. It revealed that the culture of Sarkuysan rested on the four main value pillars of storytelling, trust, continuity and loyalty and the two supportive pillars of top management support and its reward system.

The first element of Sarkuysan's organizational culture is based on ''storytelling'' within the company, where conventional command-and-control approaches to achieve new goals and behaviors have tended to be counter-productive (Denning, 2006). Interaction between individuals is essential in the innovation process as the dialogues are often the basis for the creation of new ideas and can therefore be viewed as having the potential for creating knowledge (Denning, 2006). Employee interaction should be encouraged, both formally and informally, it is important that organizational structures be designed for flexibility as opposed to rigidity so that they encourage sharing and collaboration. The study thus illustrates how knowledge creation is achieved when tacit and explicit knowledge interacts to achieve innovation and the creation of organizational knowledge.

The fifth model that was considered was Nonaka and Toyama's *'dynamic theory of knowledge creation'.* This model consists of three approaches:

- the SECI process , i.e. knowledge creation through the conversion of tacit and explicit knowledge. "It is important to note that the movement through the four modes of knowledge conversion forms a spiral, not a circle" (Nonaka and Toyama, 2002:12). In the spiral of knowledge creation, the interaction between tacit and explicit knowledge is enlarged through the four modes of knowledge conversion.
- 'ba', i.e. the shared context for knowledge creation; 'ba' can emerge in individuals, working groups, project teams, informal circles, temporary meetings, and virtual space such as e-mail groups
- the inputs, outputs and moderating factors of the knowledge- creating process; for example when there are high levels of trust in the organization (Nonaka et al ,2000a, Nonaka& Takeuchi, 1995)

According to the framework, the main factors influencing knowledge management consists of socialization (from tacit knowledge to tacit knowledge), externalization (from tacit knowledge to explicit knowledge), combination (from explicit knowledge to explicit knowledge) and internalization (from explicit knowledge to tacit knowledge). (Nonaka et al, 2000a). By

considering these four influences a clear picture emerges of how knowledge management unfolds in an organization.

In the socialization process people empathize with their colleagues and customers, which diminish barriers between individuals. Basically, frequent physical interaction and observation help promote sharing and collaboration. The externalization of knowledge often helps people to see that the same phenomenon can be viewed in many different and contrasting ways. In combination, new knowledge generated through externalization transcends the group to be combined. In internalization, individuals reflect upon themselves by putting themselves in the context of newly acquired knowledge and the environment where the knowledge should be utilized (Nonaka and Toyama, 2003)

This framework emphasis that for effective KM to take place that will stimulate innovation interaction between individuals is essential. Dialogue between individuals or groups is often the basis for the creation of new ideas and can therefore be viewed as having the potential for creating knowledge and promoting innovation. Employee interaction should be encouraged, both formally and informally, so that relationships, contacts, and perspectives are shared by those not working side by side. This type of interaction and collaboration is important when attempting to transmit tacit knowledge between individuals or convert tacit knowledge into explicit knowledge, thereby transforming it from the individual to organizational level. (Nonaka and Toyama, 2003)

This distinction represents what could be described as the epistemological dimension of organizational knowledge creation. It involves a continual dialogue between explicit and tacit knowledge which drives the creation of new ideas and concepts. Although ideas are formed in the minds of individuals, interaction between individuals typically plays a critical role in developing these ideas. That is to say, communities of interaction contribute to the amplification and development of new knowledge (Nonaka et al, 2000). While these

communities might span departmental or indeed organizational boundaries, the point to note is that they define a further dimension to organizational knowledge creation, which is associated with the extent of social interaction between individuals that share and develop knowledge. This is referred to as the ontological dimension of knowledge creation.

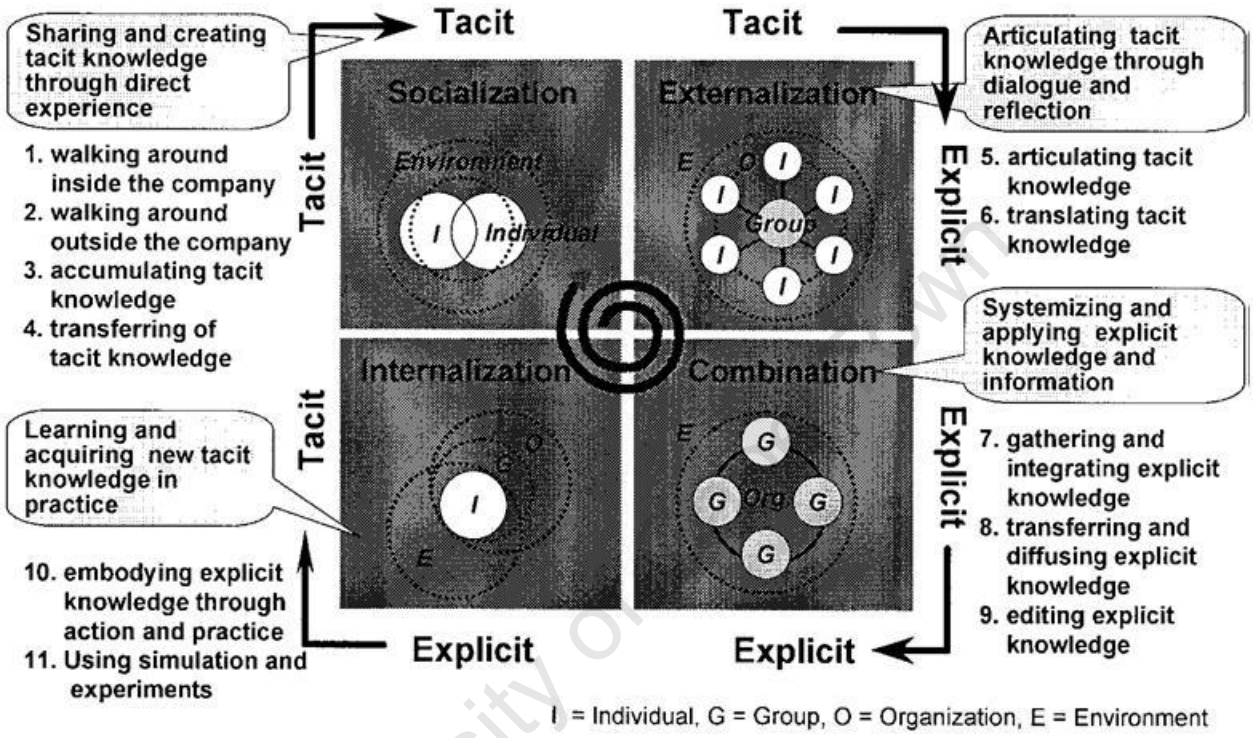

FIGURE 4.1 Four modes of knowledge conversion: Nonaka & Toyama (2003)

The sixth model that was considered was Heisig's "Generating *Knowledge Model*". Heisig (2009) was of the opinion that there are two main aspects that reflect the focus of a KM strategy .The first aspect relates to system and human strategies. System strategy emphasizes the capability to create, store, distribute and apply an organization's explicit knowledge, and human strategy stresses knowledge sharing through interpersonal interaction utilizing dialogue by means of social networks such as teamwork.

The second component of Heisig's model relates to the processes of KM. Although many scholars view KM process in different ways, there are is generally agreement on the four most basic and important processes, viz.:

1. Knowledge Creation;

2. Storage;

3. Distribution; and

4. Application (Heisig, 2009).

The model, as outlined below, reflects continual knowledge building and this further resonates with Quintas' (2002) argument that organizations that wish to innovate usually focus on the need to build their knowledge bases cumulatively.

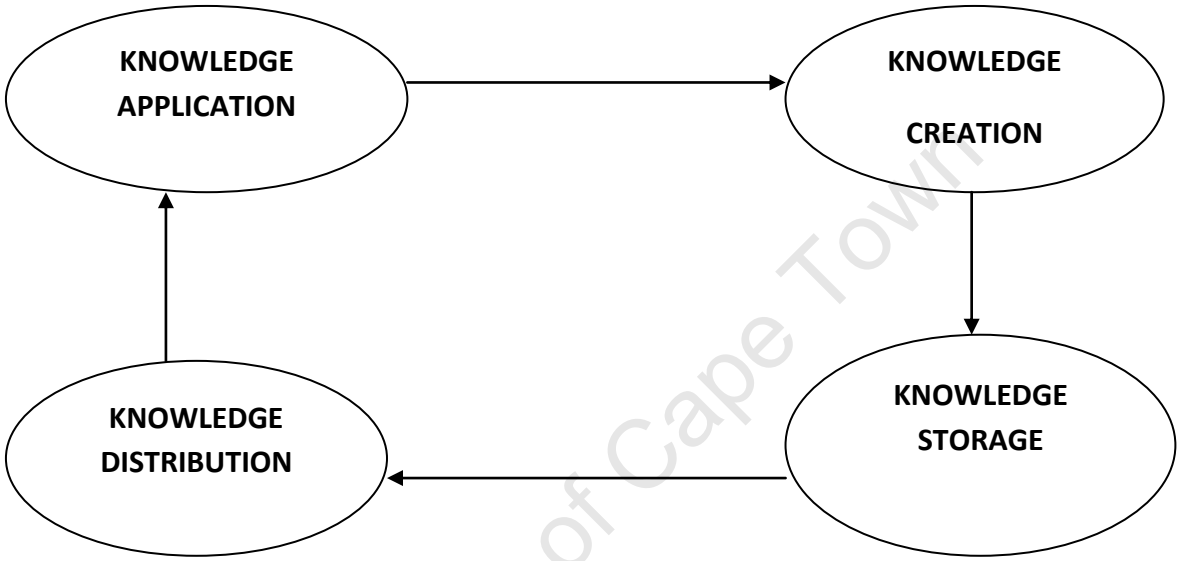

FIGURE 4. 2 KM process: Adapted version and modified from Heisig (2009)

According to Heisig's model, the first KM process is knowledge creation which refers to how organizations develop new content or replace existing content - this part of the process he adapted from Nonaka and Toyama's (2003) four modes of knowledge conversion. Then, in an effort to prevent losing track of the acquired knowledge, it has to be stored in such a way that it becomes part of the organizational memory and the organizational knowledge made retrievable. (Heisig, 2009). He then refers to knowledge distribution that aims to provide the right knowledge to the right person at the right time .Lastly, the most essential KM process, i.e. where knowledge is applied and it contributes to organizational performance and it is used for decision-making and performing tasks.

4.7 Summary of the Discussion of the Models

From the above it is clear that all six models agreed that to compete effectively, organizations must leverage their existing knowledge and create new knowledge that favorably positions them in their chosen markets. However, the conclusion reached from an analysis of the models is that there can never be a 'one size fits all' kind of approach because each organization has its unique information and knowledge needs. The six models discussed above provided valuable input into the development of a model for this research project in that there are aspects of the models that are deemed to be particularly relevant for collaboration in an organization for effective knowledge management.

4.8 Limitations of the Models

First, all of the models are somewhat weak in terms of external validity. The researcher after analyzing the models, however, found that the Heisig (2009) and Nonaka and Toyama's (2003) models were the most suitable for the study.

With regard to the Chase, Gold, Malhotra and Segars, Swan and Nayir and Uzunicarsili's models it is has been reported that they are more relevant to technology-intensive companies with high research and development expenditures than organizations that are not as well endowed (Nonaka and Toyama, 2003). As this research is based in a research organization in a developing country caution is required when applying such models. The researcher is thus of the opinion that the models that were not used do not provide a total picture of knowledge management activities as they cannot be adapted to all international cultures and the activities of non-profit making sectors. The models were therefore inadequate to be used as a framework for the exploration of knowledge management practices and challenges for this research.

For instance, Nayir and Uzumcarsili's study is limited because they do not focus on research organization in less advanced economies. The Swan et al. model is likewise limited because it does not recognize the need to create some shared understanding through active and involved networking. Rather there is the view that as long as the networks are structurally in place, then

knowledge sharing across the internal boundaries would happen almost effortlessly. The focus is on the technology to develop intranet systems and the technical infrastructure required to enable such networks. Very little attention is paid to encouraging employees to engage in active networking to share knowledge and to local organizational and cultural differences.

The limitation of Gold, Malhotra and Segars' (2001) model is that the model fails to discuss the importance of knowledge creation and of innovative ideas in an organization. It does not indicate how to capture and store these ideas (basically tacit by nature) and how to transform them into explicit forms that enhance effective knowledge sharing for efficiency. The researcher rejected the '*Skandia Intellectual Capital model*' based on the fact that the model ignores the human and social aspects of KM; it assumes KM can be decomposed into objective elements rather than being a socio-human phenomenon and that objective measures can be related to subjective elements. In summary, intellectual capital models are mechanistic in nature, and assume that knowledge can be treated as an asset, similar to other assets.

4.9 Contextualizing the Models

Identifying and reviewing previous case studies served the purpose of broadened the researchers understanding of how knowledge management functions in relation to the models she had selected and it further added context. For this purpose the researcher selected two case studies of knowledge management previously carried out, to analyze and provide context.

Case Study One - NTT DoCoMo's Launch of I-Mode in the Japanese Mobile Phone Market: *'A Knowledge Creation Perspective'*

This case study provides a good example to demonstrate the applicability of Nonaka and Toyama's model as well as the first process of Heisig's model. It explains how key managers created and organized an interlinked system of shared contexts, called '*ba'*, "ba should be understood as a multiple interacting mechanism explaining tendencies for interactions that occur at a specific time and space. "Ba can emerge in individuals, working groups, project teams, informal circles, temporary meetings, virtual space such as e-mail groups, and at the

front-line contact with costumers" (Nonaka and Toyama, 2003:6). The knowledge creation theory provides a holistic framework for describing organizational innovation and knowledge creation. Tacit knowledge that is acquired is of little use unless it is externalized and shared. Exposure to diverse ideas during the externalization phase is important in every step in the innovation process. (Nonaka et al., 2000)

The case study also emphasizes the neglected role of context in the innovation and knowledge creation processes. The 'i-mode' case study shows that the creation and organization of various interlinked shared contexts (ba) within DoCoMo and external partners facilitated the creation and successful launch of an 'i-mode' service. Each of the key managers already possessed rich tacit knowledge that helped smoothen the 'i-mode' innovation process. The selection of key managers and the creation of supporting '*ba'* in which their diverse tacit knowledge and that of external partners was shared and synthesized were made possible by human dynamics and social networks. (Nonaka and Toyama, 2003).

The case study, therefore, shows that not only initial concept creation, but also the efficient integration of interlinked entities explains the success of the 'i-mode' project. Knowledge was transferred and combined during the combination phase, for example, when engineers at DoCoMo and hardware manufactures exchanged blueprints and specifications.

Case Study Two – 'Knowledge based view of radical innovation'

The second case study relates to Nonaka et al's (2000), account of the application and success of knowledge management in the Toyota car manufacturing organization. The case study demonstrated how SECI and 'ba' acted as a dynamic coherence in knowledge creation and innovation (Nonaka et al., 2000.). Nonaka et al's study challenged other findings that overlook the importance of understanding how the interactions among employees are dynamically linked to form a continuously evolving whole, which, in turn, impacts on the organization. The study emphasizes the importance of knowledge creation and distribution and can be related to

the four modes of communication in the Nonaka and Toyama's knowledge creation model as well as the third process of Heisig's knowledge generation model.

4.10 Proposed Knowledge Management Framework for this Study

The researcher adapted and applied Nonaka and Toyama's (2003) knowledge management model relating to the dynamic theory of knowledge creation and organizational knowledge sharing and Heisig's (2009) knowledge generation model to investigate knowledge management practices in the CSIR. The researchers decided on these two models because in her view they provided the most comprehensive explication and framework for knowledge management that would best relate to the unique circumstances of the CSIR in Ghana. They best described knowledge management as not only focusing on knowledge creation but also clearly indicated the spiral relationship of knowledge creation, storage, distribution and application as well as the various KM processes. It was clear from the knowledge management literature that was reviewed and especially the different models investigated for this project that it is imperative that a tentative framework be derived to understand the knowledge management processes and to provide a framework for this project.

The intention is to use the models to guide this research project and to provide a framework to answer the major research questions pertaining to how the CSIR manages and shares knowledge covering elements such as the people, the organizational culture, the processes and the technology. Combining all the factors together the researcher arrived at the table below summarizing all the components of the framework that can be addressed for the analysis of knowledge management and challenges at the CSIR.

Research Questions	Main Criteria
1. Are the cultural and social practises at the CSIR conducive to knowledge management and the generation, acquisition, use and sharing of knowledge?	Follow Nonaka and Toyama's model-research institution characteristic ,**internalization** of knowledge (Explicit→ Tacit ; acquiring Knowledge through practice) and **Externalization** of knowledge (Tacit Explicit ; Dialogue and reflection) Follow Heisig's model - KM first and second processes - **Creation** and **Storage**
2. Are the CSIR's organizational practices and procedure assisting or inhibiting the interaction with knowledge and the practice of knowledge management?	Nonaka and Toyama's model, research institution characteristic -**Socialization** of knowledge (Tacit→ Tacit ; Direct experience) Follow Heisig's model - KM third process - **Distribute**
3. Does the CSIR have an adequate information communication platform that is utilised to leverage knowledge management practises?	Nonaka and Toyama's model Technology transfer institute characteristic, **Combination** of knowledge (Explicit→Explicit ; systemizing knowledge)

Table 4-1 Comparing Research Questions to the two theories of KM: Source: Author; Nonaka and Toyama, 2003; Heisig, 2009.

From the above the researcher developed the following model to serve as the guiding framework for the research project:

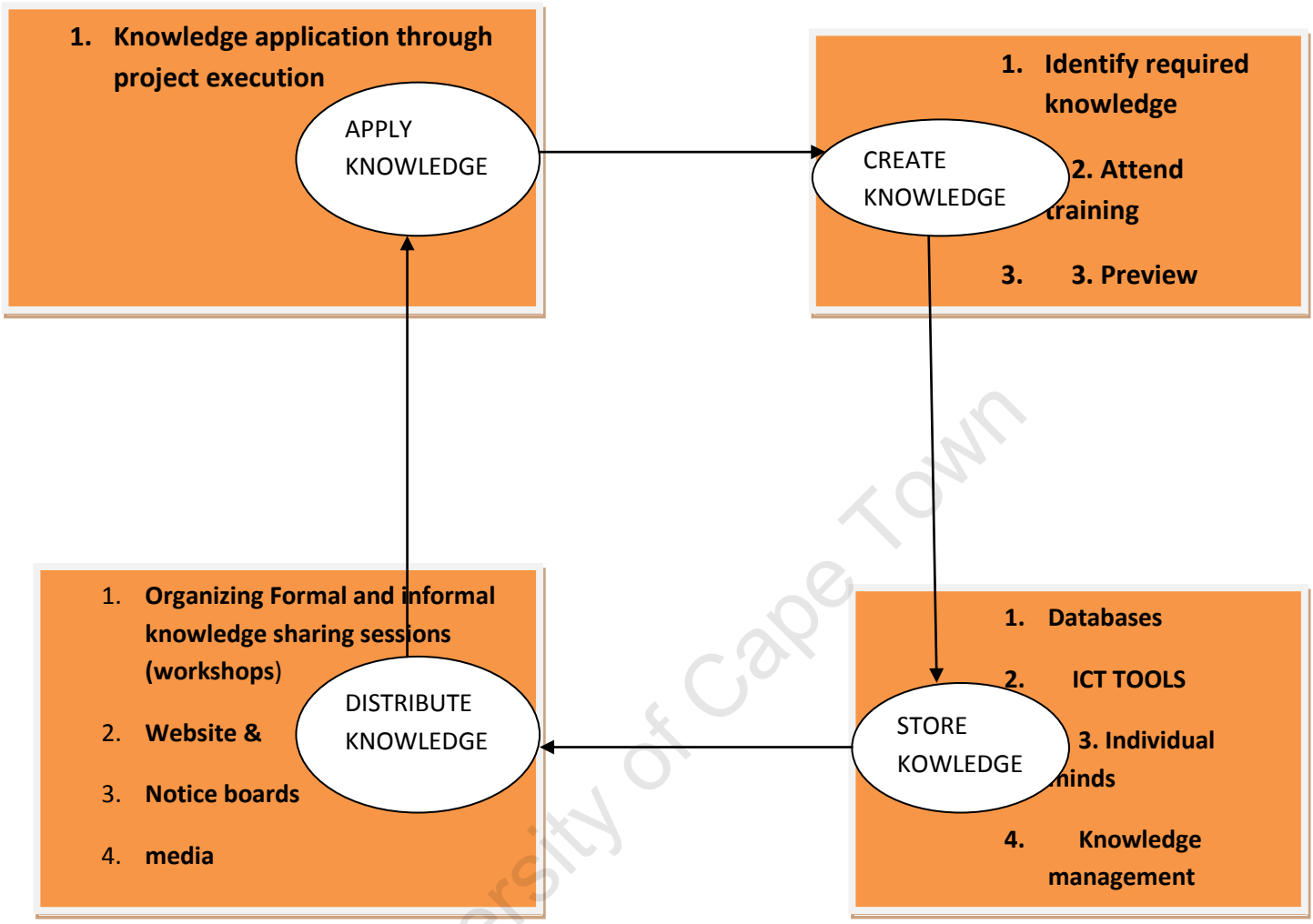

FIGURE. 4- 3 A framework adopted for CSIR Knowledge management strategies overview- Adapted and modified from Heisig (2009)

4.11 Conclusion

In this chapter the researcher investigated and evaluated a number of knowledge management models that could serve as a suitable framework for her study of the state of knowledge management at the CSIR in Ghana. After careful consideration she decided to select and adapt the models outlined by Nonaka and Toyama and that of Heisig to serve as the framework for her research project.

5.0 CHAPTER FIVE : RESEARCH METHODOLOGY

Well for a start, there needs to be recognition that there is no best type of research. There are only good questions matched with appropriate procedures of inquiry, and this is always driven by the researcher, not the method. It is up to the researcher to thoughtfully put together the pieces of the jigsaw in order to form a meaningful picture of the world being explored. (O'Leary, 1998)

5.1 Introduction

This study was conceived with the aim of investigating the practices, procedures and challenges of knowledge management in the Council for Scientific and Industrial Research in Ghana. The specific objectives of the study were to:

- investigate the extent to which the employees in the organization are motivated to contribute to knowledge creation and sharing;
- discover the challenges and problems the organization faces in managing knowledge;
- explore the use of ICT tools such as portals, social networking tools, etc. in knowledge dissemination among CSIR employees and its stakeholders,
- Find out the extent to which learning takes place in CSIR and establishes how the organization determines the knowledge it requires for its operations.

This study derives its significance from the growing realization of the importance of knowledge as a strategic resource that makes the difference between success and failure of both profit and non-profit organizations. The definition of knowledge management the researcher has found to be particularly relevant to this project (cf. chapter 4) and which she has adopted as the underlying framework for this study is a synthesis of those provided by Nonaka & Toyama (2002) Heisig (2009) where they suggested that

- the knowledge-generating process is context-specific in terms of time, space, and relationship with others, and
- Knowledge management consists of four basic processes (knowledge creation, storage, distribution and application) that form a spiral that encourages employees to share and leverage their knowledge to meet organizational objectives.

The research project further focused on identifying and analyzing the flow and use of knowledge within the functional areas of project implementation at the CSIR in Ghana. In order to do this, the organization's KM initiative was studied to understand the development of infrastructure and the process capabilities that are required to share knowledge effectively.

5.2 Research Design and Process

The researcher employed two major research procedures in this study. The first was a synopsis of the literature covering aspects of knowledge management that were pertinent to the study (cf. chapter 3). The literature review helped to clarify concepts and further provided the basis for the theoretical framework for this study (cf. chapter 4). The second was an empirical study conducted at the CSIR to assess the state of procedures and practices of knowledge management and the challenges the organizations faces in managing knowledge effectively and efficiently.

Prior to examining the various specific aspects relating to the research design and methodology adopted, the researcher will first outline the overall decisions taken throughout the research process. Many schools of thought have indicated that it is important to document the empirical process, which should be followed as carefully as possible to ensure later replication and verification. Five distinguishable steps have been identified by Mouton and Marais (1990:24) which they suggest an investigator should follow to ensure the success of an empirical research project:

- Selecting a research topic
- Formulating the research problem
- Conceptualization and operationalization
- Data collection
- Analysis and interpretation of the data.

In addition to these five stages of the research process, the researcher added two more stages; the presentation of the final research report and implementing the research findings. For this purpose, a diagram of the procedures and steps followed in this study is presented as Figure 5.1 below. Although the processes are depicted sequentially, this by no means suggests that the interactive nature and complexities of the research process can or in fact was reduced to a simplistic step-by-step procedure (cf. Mouton and Marais, 1990).

Discover the organizational needs
and Research questions

Research Proposal

Research Design

Data collection and
preparation

Data analysis and
interpretation

Research Reporting

Implementing the
Research Findings

FIGURE 5.1 A flowchart indicating the research process. Adapted and modified from Mouton and Marais (1990:24)

The overall research approach that can generally be adopted in any study relates to whether the research project is qualitative or quantitative by nature. Qualitative research explores attitudes, behavior and experiences. It attempts to get an in-depth opinion from participants. Myers and Avision (2002) argue that qualitative researchers stress the socially constructed nature of reality, the intimate relationship between the researcher and what is studied and the situational constraints that shape inquiry. They seek answers to questions that stress how social experience is created and given meaning. The qualitative model is thus characterized by an emphasis on the study of human action from the insider's perspective where description and understanding play a more important role than the explanation and prediction of human behavior. The emphasis is to stay close to the research subject and this would thus imply the use of data collection methods such as unstructured interviewing, focus group interviews, participant observation and the examination of personal documents. Babbie and Mouton (2001:49-54).

In contrast, quantitative research generates statistics through the use of large-scale survey research, using methods such as questionnaires or structured interviews. This type of research, while reaching many more people, has less contact with those people and does not probe to the same level of depth as in qualitative research. Quantitative research methods were developed in the natural sciences to study natural phenomena. In quantitative research, the research results are proven to a known degree of accuracy because the data were derived from a representative sample and sources of error are rigorously controlled (Rea and Parker, 2005:73). Quantitative studies place a particular emphasis on the quantification of constructs; variables play a central role in describing and analyzing human behavior. In a quantitative study, the focus is thus on control and on how variables are related. (Rea and Parker, 2005)

A research project need not, however, be aligned to only one or the other of the above approaches, but can utilize a combined or mixed methods approach where the most appropriate attributes of both are adopted, i.e. using a triangulated approach to increase objectivity and validity (Babbie and Mouton, 2001:274). The research design adopted for this study used such a mixed method approach and drew from both qualitative and quantitative techniques.

5.3 Research Design and Research Questions

The aim of a research design is to have a planned structure and strategy for collecting and utilizing data so as to meet objectives and obtain accurate answers to a research question or problem. Research designs could be referred to as the 'glue' that holds all the components of a research project together, which could also be said to be the strategic plan for a research project or research programme. It sets out the broad outline and key features of the work to be undertaken, including the methods of data collection and analysis to be employed, and indicates how the research strategy addresses the specific aims and objectives of the study (Mouton and Marais, 1990). According to Babbie and Mouton (2001), obtaining relevant evidence entails specifying the type of evidence needed to answer the research questions, to test a theory or hypotheses, to evaluate a programme or to accurately describe some phenomenon. A well constituted research design thus helps a researcher to determine the kind of evidence he or she needs to successfully conclude a research project. It further formalizes the research process and methods to be used in the study and indicates the "set of decisions regarding what topic is to be studied among what population with what research methods" (Babbie, 1999:104).

De Vaus (2001:9), in turn, is of the opinion that the aim of a research design is to plan and structure a given research project in such a manner that the eventual validity of the research findings is maximized. By developing a well structured research design, the researcher thus ensures that the evidence obtained resolves the research problem as unambiguously as possible. It is the opinion of this researcher that an essential component of any research design

are the hypotheses or research questions that should serve as the framework for the research project.

Locke, Silverman and Spirduso (2004) further suggest that the process of research, that is, its operationalization, begins when a researcher formulates carefully defined research questions or hypotheses that clearly conceptualize the problem under investigation and then designs a systematic way to collect information that might provide an answer. In research, a hypothesis is a prediction of the outcome of a study; the prediction may be based on an educated guess or a formal theory. Such hypotheses are usually testable statements indicating specific predictions that can be tested via one analysis - they thus identify specific relationships between variables.

While hypotheses are generally formulated to serve as the organizing framework for research projects within the quantitative domain, it is recommended to rather use research questions in more qualitative studies (Punch, 1998). Research questions formulate the research problem as questions that have to be answered by the empirical study. They are not as restrictive and rigidly embedded in the scientific paradigm as hypotheses.

Since this research project was significantly embedded in a qualitative research paradigm, research questions rather than formal hypotheses were thus formulated to serve as the framework for the empirical study. The research questions that formed the framework for this thesis evolved from the objectives of the study and the development of the theoretical framework for the study (cf. Chapters 1 and 4).

To fulfill the research objectives of the study (cf. 5.1 above), the researcher formulated the following key research questions to guide the investigation:

- Are the cultural and social practises at the CSIR conducive to knowledge management and the generation, acquisition, use and sharing of knowledge?
- Are the CSIR's organizational practises and procedures assisting or inhibiting the interaction with knowledge and the practise of knowledge management?

- Does the CSIR have an adequate information communication platform that is utilised to leverage knowledge management practises?

5.4 Research Method Used for the Study

"A research method is a strategy of inquiry which moves from underlying philosophical assumptions to research design and data collection"(Myers and Avison, 2002:7).

The choice of research methods influences the way in which the researcher collects data. Specific research methods also imply different skills, assumptions and practices. The major purpose of a research project is to discover new knowledge and this involves the discovery of new facts, their correct interpretation and practical application. (Babbie and Mouton, 2001). Having clarified the overall design decisions that should be taken, the researcher studied all possible research methods that would satisfy the requirements of this research project and decided to concentrate on two possible approaches, viz. case studies which are orientated towards qualitative research approaches, and surveys, the most well known social science method in the more quantitative domain.

The objective of this research project (as outlined above) was to investigate the status of knowledge management initiatives and the exchange and use of knowledge at the leading scientific research organization in Ghana. The fact that the research project focused on a single organisation indicated that a modified case study approach would be appropriate for this study (Yin, 2009). The advantage of utilizing a case study approach was that it would allow the researcher to focus on the CSIR and examine the relevant knowledge management themes and issues in detail (Stark and Torrance: 2005). Case studies are becoming an increasingly important approach because they facilitate the investigation of little-known phenomena in complex organizations such as the CSIR. McCall et al. (2008) further argue that empirically based case studies have the potential to contribute to the development of both theory and practice. The main limitation of this approach is that the findings cannot be generalized.

Survey research, in turn, is considered the best method available to a researcher interested in collecting data from a data set or source too large to observe directly. Surveys thus provide a good overall perspective of a field and may be used for explanatory, descriptive and exploratory purposes. The units of analysis in surveys are usually individual people or groups where individual persons serve as the informants or respondents.

Having considered the advantages of both surveys and case studies the researcher decided to combine the best attributes of case studies with surveys and to conduct a relatively small-scale survey that would approximate the depth attributes of a case study. In this way both qualitative and quantifiable data that related to the research topic could be collected. This would further satisfy the requirements of a triangulated research design as indicated above. A cross-sectional design was selected, i.e. the research project was contained to one specific investigation within a particular time span. Such a research project thus reflects the characteristics, behavior, opinions, etc. that are prevalent at that particular time.

Problems encountered with many research methods and particularly surveys are that although they provide an effective method to examine the products of social activities, they are not the ideal method to use to examine the activities themselves (Bailey, 1994:288). There is further considerable dependency on a respondent's understanding of the situation as well as possible subjective bias that both the researcher and respondent might introduce. These problems however, are encountered in most social science research methods, and the best means of resolving them are to be fully aware of their existence and to offset the adverse effects. Respondents should, furthermore be encouraged to fully participate and to identify themselves with the value of the research project.

5.5 Data Collection

Starting off with precise research questions or hypotheses, as suggested by Yin (2009), creates a behavior where the researcher sets out to look for what he or she thinks is out there. The questions that guided the collection of data for this project are outlined in 5.3 and in summary can be outlined as investigating how knowledge assets are developed, kept and disseminated in the CSIR to improve organizational processes.

Eisenhardt (1989: 534) is of the opinion that when conducting research and particularly case study research the investigator should combine and triangulate data collecting methods such as interviews, questionnaires and analyzing documentary sources. Liebowitz and others (2000) further also emphasize the value of using more than one method and suggest combining the informal interaction provided by interviews with the use of questionnaires as the best technique to collect data. The researcher thus deployed three data collection techniques for this study. While questionnaires were the primary method, it was supplemented with, and enhanced by interviews and an analysis of documentary sources such as back-to–office reports and handing over notes.

5.5.1 Questionnaires

Questionnaires (cf. appendix A) were administered to all key staff members who were most likely to make an impact on the decision making process in the CSIR. Respondents thus comprised of the scientific researchers, technology transfer staff and general support staff (human resource personnel, information technology (IT) and the logistic staff).The researcher obtained appointments to personally administer the questionnaires and asked the respondents to complete the questionnaires in her presence so that she could clarify any ambiguities or anything that was not clear to the respondents. This further assisted in obtaining a high response rate. The researcher thus obtained responses from the 75 questionnaires that were administered at eight of the thirteen research institutes in the CSIR. She could only, due to time constraints, cover eight institutes.

A questionnaire structure was prepared that addressed all the factors raised in the research questions that underpinned this study (cf. 5.3).

The questionnaire contained a list of questions about the need for and use of knowledge and various knowledge management practices in the CSIR. The researcher mostly utilized closed-ended and or fixed questions as they enabled her to present alternatives from which the respondents could select options which were the closest to their own opinions or views. Such questions can help to clarify the intent of the question for the respondent if the area of investigation is unfamiliar to them. The structured questions were mostly in a Likert scale type format and respondents are asked to strongly agree, agree, disagree, or strongly disagree with the statement (cf. Babbie and Mouton, 2001). There was also the option not to comment at all. The researcher also made provision for respondents to state their own points of view regarding knowledge management in their organizations. The questionnaire structure (cf. appendix A) was constructed and divided into four sections with relevant questions posed in every section as follows:

Questionnaire Structure
SECTION ONE: Background Information and Profile.
The section one sought the personal profile of the employees of CSIR, where, employee's name, department worked, number of years worked, age bracket and educational level were solicited.
SECTION TWO: Organizational Culture and Social Structures
From an organizational point of view, Marguardt (2002) states that culture is an organization's values, beliefs, practices, rituals and customs. Section two discussed and gathered information on whether the organization encourages formal and informal opportunities for individuals to share their innovative ideas.
SECTION THREE: Organizational Practices and Procedures
Section three investigated how the organization identified and managed its knowledge assets. It gathers information about who has access to the information.
SECTION FOUR : Information and Communication Technology
Information and communication technologies support and enable knowledge management. The questions in this section addressed the issues of investment of ICTs, the kind of information technologies invested in and the ease of access and use of information technologies by organizational staff of the organizations investigated.

Table 5-1: An outline of issues addressed in the questionnaire.

5.5.2 Interviews

Interviews are one of the most important ways of gathering information and knowledge. This is because respondents are encouraged to express their views freely as well as feeling a part of the research process. It has been realized that by asking people directly what is going on is an obvious way of seeking answers (Yin, 2009). Interviews further also provide for more in-depth

data about the topic being investigated. Interviews are also credited for the chance they may afford the researcher to probe and follow-up on any interesting issues that may crop up in the course of the interview. It was for these reasons that the researcher decided to conduct interviews with twenty of the respondents in strategic positions.

The researcher used face-to-face interviews as a technique of collecting data for this study because

- of the expected high response rates
- she had reasons to believe that in the course of the face-to-face interviews, she could observe the non-verbal behavior of the respondents, which could afford her the opportunity to follow-up observed clues and break away from the interview schedule when appropriate
- the researcher was convinced that the face-to-face interviews could allow her to take control of the interview environment and give the interview direction
- It provided an opportunity to establish rapport with the subject, stimulate the trust and cooperation needed to probe sensitive areas and it allowed the respondents an opportunity to ask for interpretation of questions which were not clear. (Babbie and Mouton, 2003)

Bailey (1994), however, also identifies some of the disadvantages of face-to-face interviews as costly, time-consuming, and the possible intrusion of both interviewer and respondent bias. However, the foregoing advantages were found to outweigh the disadvantages and provided sufficient reason to adopt this method. The researcher further also tried to counteract the problem of bias and intrusion by conducting all interviews with care and awareness of confidentiality aspects and other personal factors (Yin, 2009). Yin (2009) further warns researchers to avoid becoming dependent on a single informant, and seek the same data from other sources to verify its authenticity.

There are several forms of interviews that are possible: open-ended, focused, and structured (Yin, 2009). For this study, the researcher focused on using both open-ended and structured interviews. In Open-ended interviews key respondents are asked to comment about certain events. They may propose solutions or provide insight into events. They may also corroborate evidence obtained from other sources. Yin (2009), argues that 'why' questions create defensiveness in respondents and therefore 'how' questions should be preferred, and that open-ended interviews should be friendly and non-threatening so that opinions, views, and processes can be correctly captured.

Interviews were conducted on-site and were initially structured around the history and emergence of knowledge management as a concept and practice within the organization, and thereafter along the theoretical propositions of the study to examine knowledge management practices and capabilities. The researcher used a conversational manner to focus on the line of enquiry and asked respondents pertinent questions about their perception of the existence of knowledge management in the CSIR.

The researcher sought permission from each informant to either use audio or video to record the interviews. Where permission was denied, field notes were taken. All effort was made to conform to the schedule and availability of each respondent. Provision was made for renegotiation of arrangements or additional questions for interviews where necessary as the study progressed. When such changes were made, they were systematically documented. For researchers who were too busy to sit through long interviews, the researcher conducted more focused interview which, as outlined by Yin (2009), are situations where the respondent is interviewed for a short period of time, usually answering a specific set of questions.

5.5.3 Document Analysis

"Documents refer to any written materials that may be used as a source of information about human behavior" (Philips, 1971:147). A typical example of document analysis (also referred to as content analysis) is the conduct of a literature review, i.e. where all relevant literature

available on several aspects of a particular problem being investigated is scanned. As a technique of collecting data, document analysis has disadvantages and advantages (Robson, 2002; Babbie, 1999:295-296). Disadvantages of the technique include the possibility that the documents available may be limited, restricted or partial and that the documents have been written for some other purpose than the intended research project and it is difficult to authenticate accuracy. Babbie (1999) adds that the technique is limited to the examination of recorded communications and that it has a possible low degree of validity. On the other hand however, the concreteness of materials studied in content analysis strengthens the likelihood of validity.

Advantages of the technique are that a researcher can observe without being observed; the data are in permanent form and hence can be subject to re-analysis and thus facilitates reliability checks and replication of studies. Babbie (1999) also contends that the relative low cost of the technique in terms of time and money is advantageous and it also permits a researcher to study processes occurring over long periods of time. From the previous discussion of the documentary analysis technique, it is clear that the technique has more advantages than disadvantages, and hence, the reason for selecting the technique. Document analysis for this study was based on an examination of the literature on knowledge management, documents such as mission statements, staff listings, annual reports, the handing-over notes of an employee exiting the organization and the back-to-office reports of researchers who attend outside conferences and organizational structures. Most of the latter documents were available of the CSIR website.

These documents were used to corroborate and augment data from the interviews and questionnaires. Where evidence from documents is contradictory, further enquiries were made. The use of multi-faceted methodologies in investing the problems, known as triangulation helped to enhance the reliability and validity of the research. (Babbie and Mouton, 2003).

5.6 Organizational Buy-in

Organizational buy-in was obtained by means of a formal letter that introduced the researcher and the project and which was sent to the director of the CSIR to request permission to investigation the knowledge management practices available in the organization. This provided the platform to speak to staff individually and set the schedules for the interviews that followed. A letter (cf. Appendix B) of introduction from the University of Cape Town's Department of Information and Library Science was presented and the objectives of the study explained. Permission from the director was given to the researcher to interact with staff and conduct interviews as scheduled (cf. Appendix C). In the introduction to the questionnaires there was a further statement indicating that the investigation was being conducted for the purposes of an MPhil research project and that data and information collected would not be used for any other purposes. Based on the positive feedback received individual appointments were made with staff in the various institutions to distribute questionnaires and conduct interviews.

5.7 Study Population and Sampling

A study population is that "aggregation of elements from which the sample is actually selected" Since the research project focused on an exploration of KM practices at the CSIR in Ghana, the study population was drawn from the population of CSIR employees. The units of analysis are the "objects that a researcher initially describes for the purpose of aggregating their characteristics in order to describe some larger group or abstract phenomenon" (Babbie, 1999:180). Bailey (1982:85) refers to units of analysis as the "objects of study." The unit of analysis most often is individual persons and in this study the units of analysis were the individual employees at the CSIR. .

As it was not possible to study the entire defined population of staff based in the CSIR, a sample of 75 employees was taken from the defined population of CSIR employees. Sampling is used extensively in the social sciences and particularly in surveys when data has to be collected from large populations. Sampling is a process whereby one makes estimates or generalizations about a population based on information contained in the sample of the entire population (Babbie and Moutou, 2003). Yeh et al., (2006), are of the opinion that, it is the goal of quality research to draw a sample that is truly representative of the total population from which the sample has been selected. .

For the purpose of collecting data for this study, participants for the research project were chosen by means of purposive sampling. With purposive sampling, the sample is handpicked to achieve some specific characteristic and "where a researcher uses his or her judgment about which respondents to choose that may best meet the purpose of his or her study" (Bailey, 1982:99). The sample was thus specifically drawn from employees in key knowledge positions who were mostly working as research scientists, but also in the technological transfer, IT and human resource sectors (more specifically logistic and conference staff).

The decision to employ purposive sampling and to select respondents from these sectors was based on the fact that these employees were the most involved with knowledge-related activities in the CSIR and would thus be the most informed and able to comment on organizational knowledge management practices. The professional researchers further have the most knowledge regarding the research done at the CSIR and the activities of the council. They also, due to the fact that they attend conferences, training sessions and collaborate with other research organizations and universities, have exposure to a wide range of research activities in Ghana in general and further abroad. The reason for also selecting logistic and conference staff was based on the fact that these employees keep track of research activities and also organise travel arrangements for the research staff and were thus considered to be valuable informants about the application of certain aspects of knowledge management in the CSIR.

The researcher further restricted her investigation to eight of the thirteen different research institutes of the CSIR as it would not have been practical both financially and time-wise to investigate all the institutes. The five institutes that were not investigated would have required the researcher to travel to regions far removed from all the other institutes that were mostly situated in and around Accra, the capital city of Ghana.

The researcher further also wanted to ensure that there were respondents from each of the three seniority levels she had identified according to the following criteria:

- Researchers who had either PhD or Master degrees, produced reports from conferences they attended, published peer-reviewed articles, and held senior-level management positions.
- Employees with a bachelors' degree, diploma or certificate and who were responsible for the supervision of staff at the lower levels were considered to belong to the middle level.
- Employees, who did not supervise any staff, were considered to belong to the lower level.

The breakdown according to the seniority of the respondents investigated is provided in Table 5.2 below. The reason why the sample total adds up to 75 and not 100 is because only the 75 respondents who completed the questionnaire are incorporated.

SAMPLE SIZE		
CATEGORIES	**NUMBER OF RESPONDENTS**	**PERCENTAGE**
Senior level	46	61.3%
Middle level	26	34.6%
Lower level	3	4%
Total	75	100%

Table 5.2 indicating the number of respondents in percentage.

From Table 5.2 it can be seen that 61.3% (46) of the respondents investigated were at a senior level; 34.6% (26) were middle level ranking staff; while the lower level employees numbered only 4% (3) of the total number of respondents used for the study.

5.14 Validity and Reliability

Reliability is the consistency, or the degree to which a research method or instrument measures the same way each time it is used under the same condition with the same subjects. Thus a measure is considered reliable if it would give us the same result over and over again assuming that what we are measuring is not changing. The higher the consistency, the higher the degree of reliability and vice versa. (Robson, 2002).

Bickman (2000) is of the opinion that validity is the strength of our conclusions, deductions or intentions. He defines it as the "best available approximation to the truth or falsity of a given deduction, proposition or conclusion". Validity thus establishes whether the results obtained meet all of the requirements of the research method. Thus validity in the pure sense refers to how well a research project actually measures what it sets out to or how well it reflects the reality it claims to represent. Kidder (1980) classifies validity into the following three categories:

- Internal validity when a research project accurately identifies casual relationships.

- Construct validity when a research project properly identifies or names variables being studied.
- External validity when a research project shows something that is true beyond the narrow limits of a researcher's study. The findings should be true not just for the particular time, place and people in a researcher's study, but should be generally true even for other times, places and people.

According to Babbie and Mouton (2003) validity and reliability of research is about enhancing the credibility, transferability, and dependability of the results (They state that this can be best achieved through triangulation. Triangulation is "the act of bringing together more than one source of data to bear on a single point". Babbie and Mouton (2003: 310) agree that a triangulated approach "greatly strengthens the usefulness of the study to other settings." (*In* discussing reliability and validity in case study research, Yin (2009) outlines what he refers to as tactics to ensure the quality of any social research. These include the use of multiple sources of evidence, allowing key informants to read the report and making sure that procedures for the research are well documented so that anyone can follow them in order to replicate the same study. However, he cautions that reliability and validity are much more complex in qualitative and particularly case study research designs than quantitative approaches. Babbie and Mouton (2003) discuss a few controls that help to counter and avoid bias when interpreting qualitative research. They highlight these as:

- "A constant check for negative instances
- research analysis critically questioned;
- checking and rechecking data and purposeful testing of possible rival hypotheses;
- devising tests to check analyses and applying the tests to the data, asking questions of the data;
- following the guidance of previous researchers to control for data quality".

The literature emphasizes that qualitative research is not easily replicable because it tries not to deliberately control research conditions and rather concentrates on recording the complexity of the situational contexts and interrelations as they occur (Yin, 2009).

The researcher did a number of things to increase the levels of reliability and validity of the findings of this study:

- The researcher employed more than one technique for collecting data (triangulation).
- A number of fixed-choice answers were provided in the questionnaire to maximize the chances of getting similar responses from the respondents.
- Interviews were conducted to support the questionnaire.
- Questions were tested to ensure that they were clear and free of unnecessary ambiguities.

5.15 Ethical Issues

Considering that research in the real world has to deal with people and the things that affect them, ethical issues are bound to arise at the planning, implementation and reporting stages of research (Gray, 2004:58).

This research project strived to maintain all ethical procedures laid down in the various codes of conduct imposed on professional researchers. One ethical principle that is often emphasized is that nothing should be done to the subjects of the research without their agreement, and that this agreement should be based on adequate knowledge, supplied if necessary by the researcher, of what is implied by consenting. Again, Gray (2004) is of the opinion that the ways in which respondents are approached during the data collection process is of paramount importance as it has an effect on the response rate. The following factors were considered to enhance respondent motivation and to ensure that the method of approach was respected:

- An introductory letter was written to the management of the CSIR. This letter was delivered personally to the secretariat for onward delivery to management. During this visit names and contact details of key respondents were collected and tentative

interview dates were scheduled. Thus the researcher obtained clearance from the management before embarking on the study.

- The researcher agreed with respondents regarding the mode of interviewing either by recorded or written forms as well as the length and duration.
- Every respondent was assured of their rights of consent, protection from disclosure of information and respect for personal privacy. Some respondents agreed to be interviewed on condition that they would not be asked questions which they considered very personal.
- The questionnaires were made free of ambiguity and baffling technical terms.
- The researcher promised anonymity and confidentiality of individuals ahead of distributing the questionnaires and the interviews and in keeping with receiving informed consent, the researcher further explained to the management and those who participated the aim of the research, who was being asked to participate and why, the kind of information that was being sought and for what purpose and that that participation and any personal information they give was voluntary.

5.16 Conclusion

This study is on the assessment of procedures, processes and challenges of knowledge management at the CSIR in Ghana. The researcher used surveys within a case study framework as the primary research methodology. She adopted a triangulated data collection approach where data was collected by means of questionnaires, interviews and documentary analysis. The researcher, although aware of some of the inherent disadvantages of the techniques she used, was convinced that the numerous advantages she has listed have provided sufficient motivation to adopt the approaches she used for this study.

6.0 DATA ANALYSIS, INTERPRETATION AND PRESENTATION

6.1 Introduction

Data analysis means the process of evaluating data using analytical and logical reasoning to examine each component of the data provided. Data from various sources are gathered, reviewed, and then analyzed to form some sort of finding or conclusion. (Velden, 2002). It can also be seen as the process by which sense and meaning are made of the data gathered. In qualitative research, the data often takes the form of records of group discussions and interviews. Through processes of revisiting and immersion in the data, and through complex activities of structuring, re-framing or otherwise exploring it, the researcher looks for patterns and insights relevant to the key research issues and uses these to address the aim and objectives of the study (cf. Chapter 1). This chapter therefore deals with the processing, presentation and general analysis of the data collected for this study. It is now generally accepted that knowledge is an important and strategic organizational resource that makes it possible for other resources to be exploited effectively and efficiently. As an important and strategic organizational resource, knowledge must be thoroughly planned for and managed so as to enable organizations to enhance productivity and competitiveness.

To effectively achieve the aim and objectives of this study, the variables that were investigated related not only to the general practices and procedures of knowledge management of the CSIR, Ghana, but also took into account variables and concepts relating to the tools of knowledge management, the presence of information and communication technologies, whether the CSIR was a learning organization and finally challenges of managing organizational knowledge.

This chapter thus presents the several steps taken by the researcher to make meaningful conclusions from the data collected. This includes both the statistical analysis of the quantitative data mostly collected by means of the questionnaires and the analytical

approaches and strategies that were followed by the researcher to analyse the qualitative data from the interviews. These results are reported in an integrated way in the following sections, i.e. pertinent factors that surfaced from the interviews have been synthesised with the analysis of the questionnaire data.

6.2 Analysis of the results from the questionnaire survey

A likert-type scaling was adopted in the questionnaire. Rating score levels ranging from 0 (not applicable) to 5 (strongly agree) were used to indicate the level of agreement with regard to various attitude statements relating to KM activities at the CSIR. The data collected by means of the questionnaire were analysized using standard descriptive statistic techniques by means of the SATISTICA Software package (version 10) and EXCEL was used to construct the summary charts and tables (see below). The full descriptive analysis from STATISTICA is appended as Appendix B. Out of the 100 questionnaires that were distributed, a total of 75 were completed, representing a good response rate of 75%. The sample of respondents who completed and returned questionnaires were working in 8 of the 13 institutes of the CSIR. Twenty of these respondents were selected for the interviews.

The completed questionnaires that were returned were firstly checked by the researcher for accuracy of the responses and missing data. The researcher next developed a code sheet in Excel that illustrated the codes for each variable and she then finally imported the data into Statistica. The code sheet proved to be an extremely useful mechanism in terms of speeding up the data entry process and the flexibility of Statistica allowed the researcher to modify the codes when necessary. Taking into account the objectives of the study (cf. Chapter 1.4); the data from the questionnaires were primarily analysed using descriptive statistics to summarise the responses relating to each variable. In turn, this permitted the researcher to identify the general trend and patterns of use of the various knowledge management practises that were investigated in the study. This was further improved by cross tabulating these results as dependent variables with the respondents' demographic details as independent variables.

These cross-tabulations were then subjected to Chi-Square significance tests and only results with a significance level of ≤ 0.05 have been selected for discussion.

The results of the analysis are presented below in the form of tables and charts and are reported as frequencies and percentages indicating to what extent various knowledge management indicators were found to be present at the CSIR. These results are then further amplified with the relevant aspects and issues that arose from the interviews with the twenty respondents. The structure of this chapter follows the order in which the research questions raised by this study are outlined in chapter one (cf chapter.1.5) and of the questionnaire (cf. Appendix A) that was based on these research questions. However, before embarking with this discussion, the researcher will present the results with regard to the respondents' demographic details which also represent the various independent variables.

6.3 Profile of the Respondents

Questions in section 1 of the questionnaire were meant to collect information on the general background of the organization which was investigated, as well as on the personal details of the respondents. These questions enabled the researcher to profile the study population to obtain an overall picture of the attributes of the respondents and the organization. Specific questions related to such aspects as the name of the respondent, which for the purposes of confidentiality was made optional, gender, position, age brackets, institute worked in, the number of years worked, work orientation and the educational qualification attained.

6.3.1 Distribution according to institution

In table 6.1 below the distribution of the respondents according to the various institutes is depicted. The Food Research Institute (FRI) was clearly the institute with the largest number of the respondents (17%) and the Science and Technology Policy Research Institute (STEPRI) had the smallest number of respondents (7%). In general, the distribution of the responses represents the same ratio as the number of researchers working in the institutes.

Institute	Number of respondents	Percentage of total
Science and Technology Policy Research Institute (STEPRI)	5	7%
Food Research Institute (FRI)	13	17%
Institute of Scientific and Technological information (INSTI)	10	13%
Soil Research Institute (SRI)	10	13%
Institute of industrial Research (IIR)	10	13%
Water Research Institute (WRI)	8	11%
Animal Research Institute (ARI)	9	12%
Crop Research Institute (CRI)	10	13%

Table 6-1: Distribution of respondents by institute (n =75)

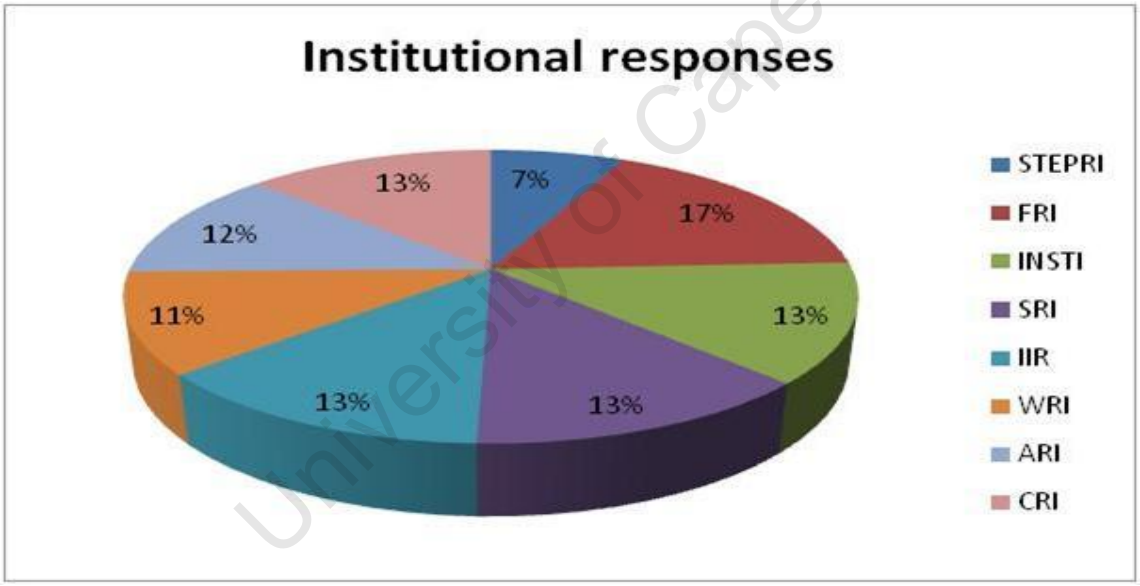

Chart 6.1: Distribution of respondents according to institutes

6.3.2 Distribution according to position categories

As was mentioned in chapter 5.13, the respondents were selected from the senior, middle and junior level categories (cf. table 6.1). As stated formerly, the reason for this selection was because for an organization to effectively capture store and disseminate its organizational

knowledge every employee has to be involved. It can be seen from table 6.2 below that while the senior management level accounted for the largest proportion (61.3%) of the respondents, those in the lower level accounted for the smallest proportion (4%). Those in the middle level accounted for just over a third (34.6%) of the respondents.

Position Distribution		
CATEGORIES	**NUMBER OF RESPONDENTS**	**PERCENTAGE**
Senior level	46	61.3%
Middle level	26	34.6%
Lower level	3	4%
Total	75	100%

Table 6-2: Percentages of ranks of the respondents in CSIR (n= 75)

The reason why the senior ranking category represented the highest percentage of the respondents was because at the CSIR, the staff engaged in active research generally hold the more senior positions while employees in the middle and lower level positions are general support staff such as those engaged with human resources, ICT technicians, etc. The researcher specifically wanted to obtain the opinions of staff actively engaged in research activities and who have expertise in diverse fields.

A number of the senior managers originally granted the researcher only a few minutes of their time for the interviews, but after the researcher explained to them the nature of the concept "knowledge management", they became interested and freely provided information that enabled the researcher to gain more insight into the CSIR and its organizational cultures and practices. Some also asked the researcher questions about knowledge management and how it is implemented.

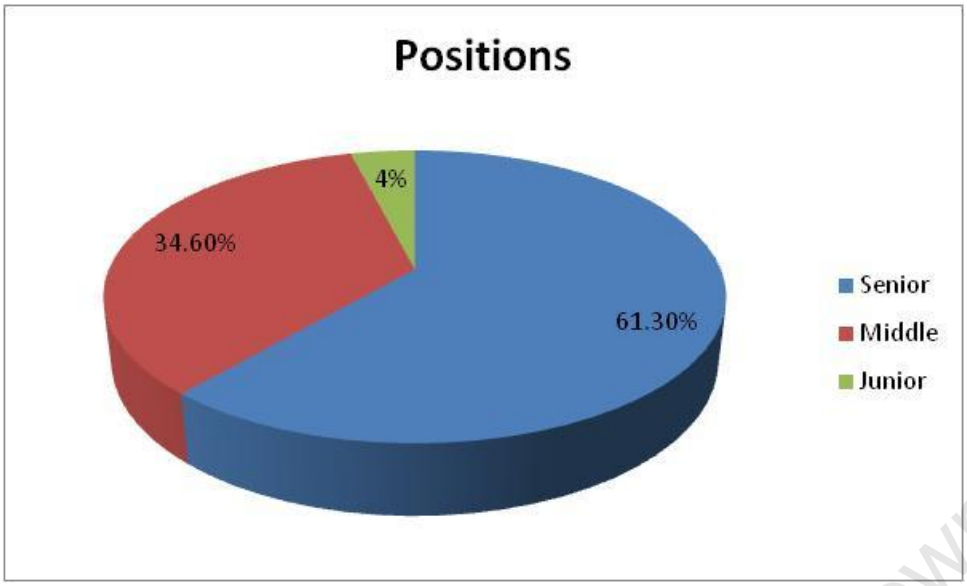

Chart 6.2: Distribution of respondents according to position

6.3.3 Age Categories

Age is generally considered to be an important factor in relation to tacit knowledge as older persons are assumed to be rich in tacit knowledge which they acquire over time and with extensive work experience, training and many years of continuous education (Nonaka and Takeuchi, 1995:148). The researcher requested the respondents to indicate which of the three age brackets, viz. below 30 years of age, between 31 and 50 and above 50 applied to them (cf. question 5, Appendix A). Since the researcher had targeted mostly scientific researchers as respondents, the assumption was made that there would be very few respondents below the age of 30 years.

Age	Percentage
Above 51	27%
31 – 50	56%
Below 30	17%
Grand total	100%

Table 6-3: Age categories of the respondents (n =75)

The data according to age categorization are depicted in table 6.3 above. It can be seen that the highest proportion of the respondents were between 31 and 50 years of age (56%), and that much smaller proportions were below 30 and above 50 years of age. Most of the respondents who were above 50 years of age occupied senior positions and the respondents in the range of 31-50 years of age were fairly equally distributed between middle level and senior level positions. Almost all the respondents younger than 30 years of age occupied lower positions.

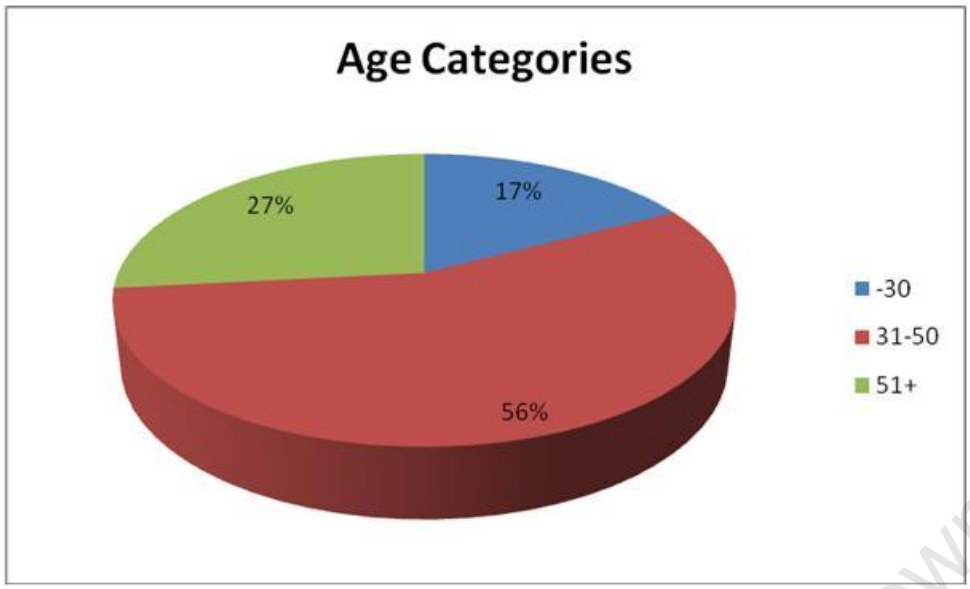

Chart 6- 3: Age categories of the respondents

6.3.4 Gender Distribution

From the data it can be seen that the gender distribution at the CSIR was very uneven (cf. table 6.4 below), with more than two thirds of the respondents being male and only 29% being female. Management explained that this skewed representation was because most of the applications for employment that they receive are from males and they presume that this is because in Ghana men are generally more interested in a scientific research career than females.

Gender	Percentage
Male	71%
Female	29%
Grand Total	100%

Table 6-4: Gender distribution (n = 75)

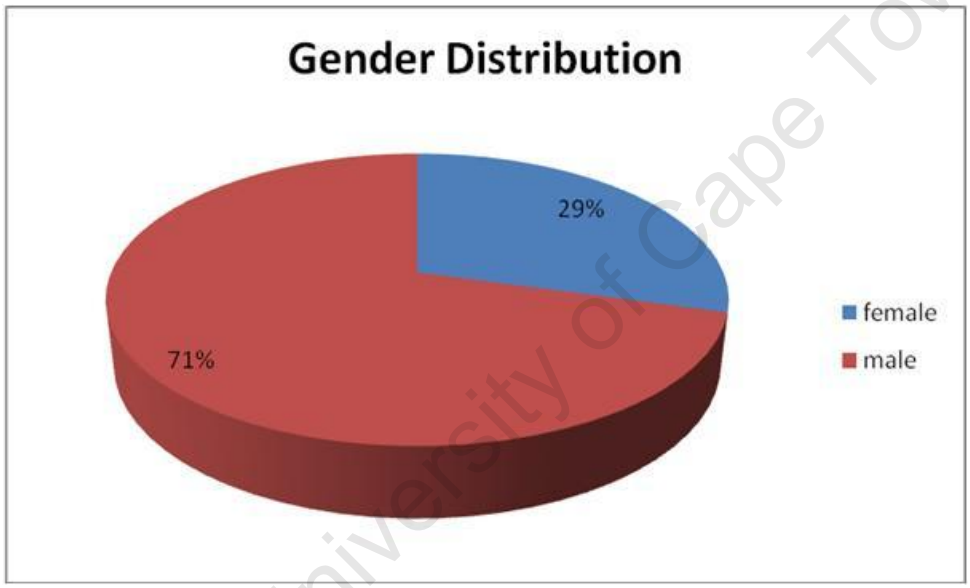

Chart 6-4: Gender distribution

6.3.5 Education level

According to Wiig (1997:97), workplace sophistication continues to increase and this requires extensive knowledge and capabilities to operate effectively in such an environment. Such capabilities and knowledge may be acquired through formal training and education or by work

experience and informal training and education. It was encouraging to note that most of the respondents had advanced formal educational qualifications (21% of the respondents were PhD holders and 49% held Master's degrees). Only 29% were Bachelor degree and high school diploma holders (cf. table 6.5 below and also question 7, Appendix A). It should be noted that all the respondents in a senior position at the CSIR held PhD degrees.

Educational Level	Percentage
Bachelor degree / High school/ Diploma	29%
Master's Degree	49%
PhD degree	21%
Grand total	100%

Table 6-5: Academic/education levels of respondents (n =75)

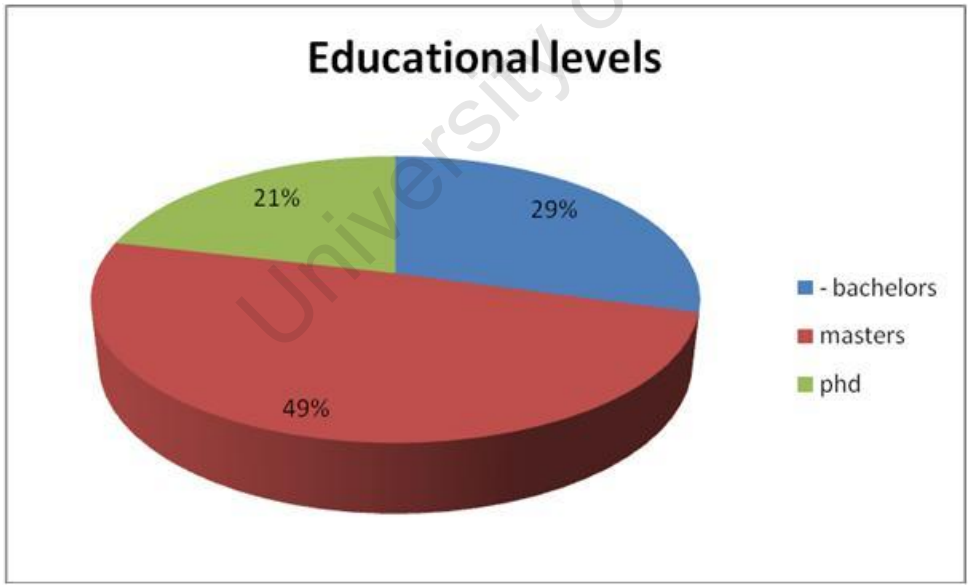

Chart 6-5: Academic qualifications of the respondents

6.3.6 Work Orientation

The respondents were grouped into two main categories; those whose work role was research oriented and those who were more involved with technological transfer (cf. table 6.6 below and also question 2, Appendix A). While the former group all attended conferences, contributed to peer reviewed documents, the latter technological transfer group were less research oriented and used information technology to disseminate the information and research findings from the scientific researchers.

Institution	Percentage
Research	67%
Technological Transfer	33%
Grand total	100%

Table 6-6: main categories of the institutes (n =75)

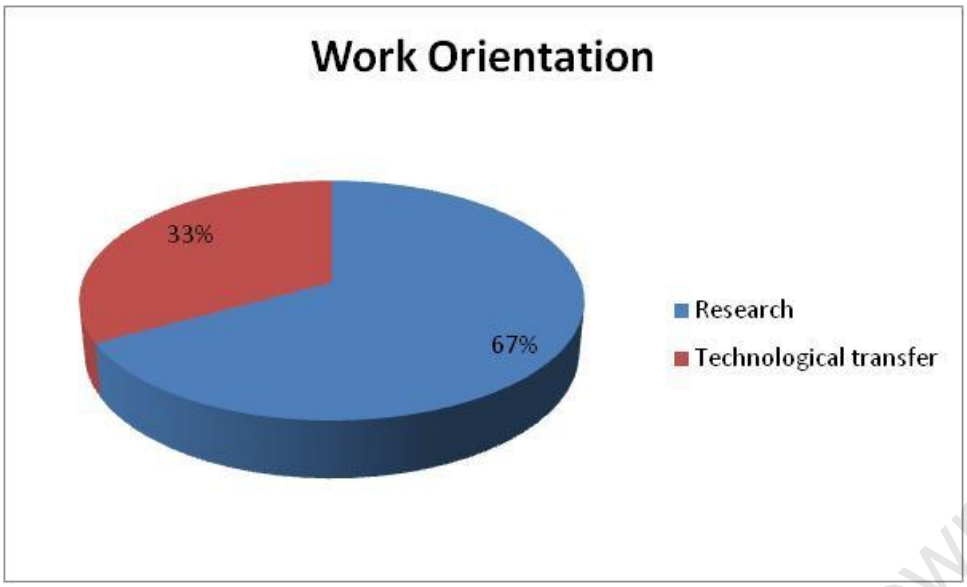

Chart 6-6: the institutes the respondents represented

6.4 Key knowledge Management Indicators

This section of the questionnaire (cf. Appendix A, questions 1- 15) sought to collect information on various factors relating to the management of knowledge at the CSIR. Taking into consideration the literature on knowledge management (cf. discussion in chapter 3), one can infer that there are certain important components that relate to its practice. The researcher is of the opinion that the most important components that would ensure effective knowledge management are related to enhancing the creation, sharing and capturing of knowledge (cf. chapter 4). Promoting these factors in the CSIR could cause a change in power structures by developing a higher degree of employee involvement and this in turn would promote work efficiency. The study thus aimed to investigate the extent to which these KM components were already being practiced, albeit unknowingly, at the CSIR. The researcher identified fifteen indicators in the literature which she considered would be the most appropriate to establish the level of KM maturity in the CSIR. These indicators were then grouped under 3 main categories, viz.: organizational structure, culture and social practices; organizational procedures and practices; and information and communication technology (ICT) (cf. Appendix A., Sections

2-4). Respondents were questioned based on these indicators and the data that was collected was analyzed and the results presented in the radar graph below.

A radar graph depicts the various variables on an axis around a central point. Each of these areas is given a score from 0 to 10. All of these points are connected. This type of graph gives a good visual representation of where the organization should ideally be and how it relates to the indicators. The aim is to move towards a situation where all areas reach 10 and the graph approximates a circle.

The radar diagram below indicates the scores categorized according to the fifteen KM practice indicators that the researcher had identified to be the most important to gauge the present state of KM at the CSIR. The radar graph indicates the aggregated scores from all the respondents (green line) as compared to the ideal situation (red line) where all the scores are 10 (the highest rating). Scores ranged from the lowest (3.7) for conference reports to the highest of (6.3) for staff debriefing.

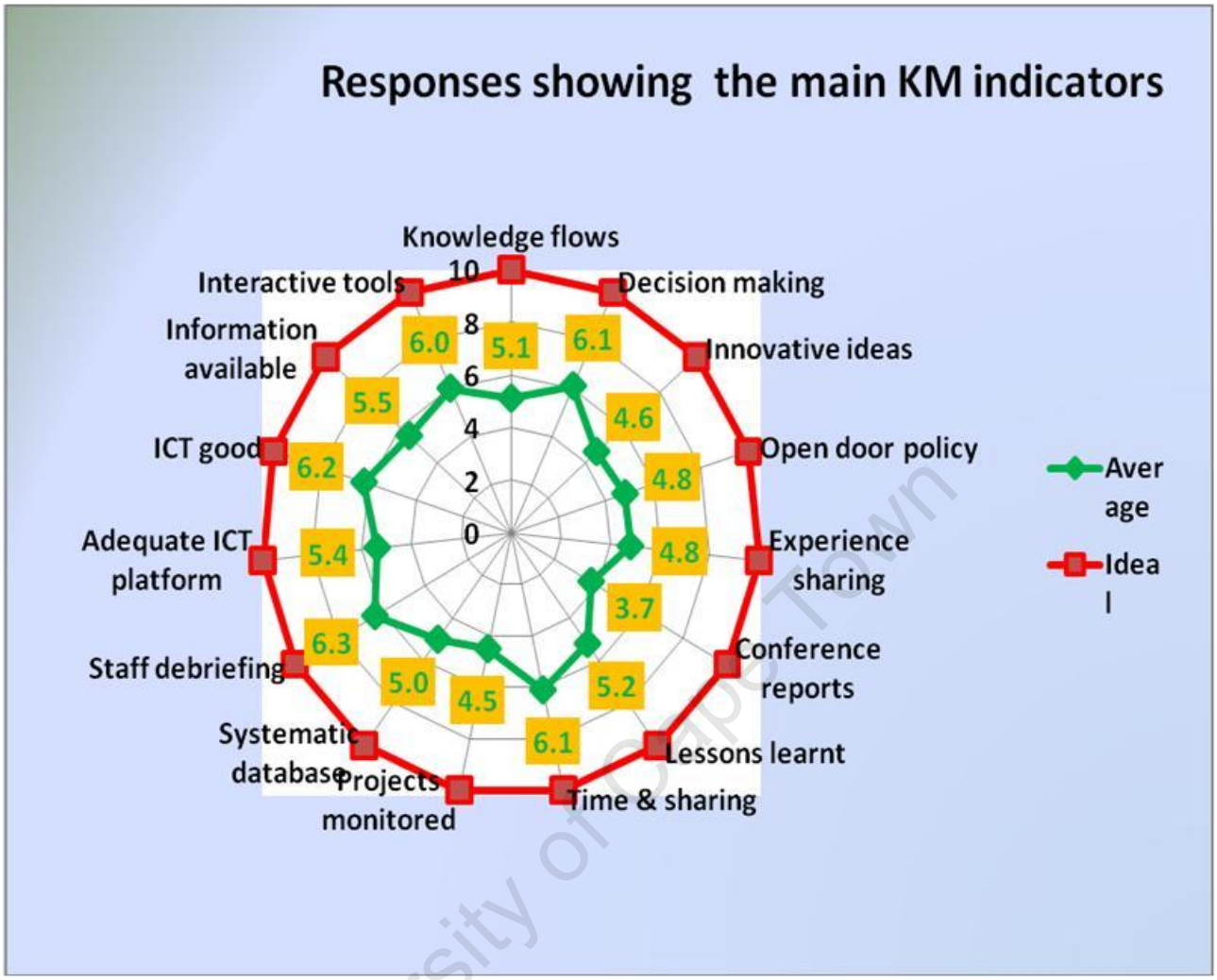

Chart 6-7 Responses showing the various KM indicators in CSIR

From Chart 6.7 above it is clear that the CSIR is still on the verge of KM implementation and practice. Only a third of the scores were in the 60% range of development, a third was hovering round the 50% mark and approximately a third was below average

In Chart 6.8 below the aggregated responses for the three main KM indicators are depicted and it is clear that they all hovered round the average score with Cultural and Social Practices at 5, Information and Communication Technologies at 5.8 and Organizational Practices and Procedures at 4.8.

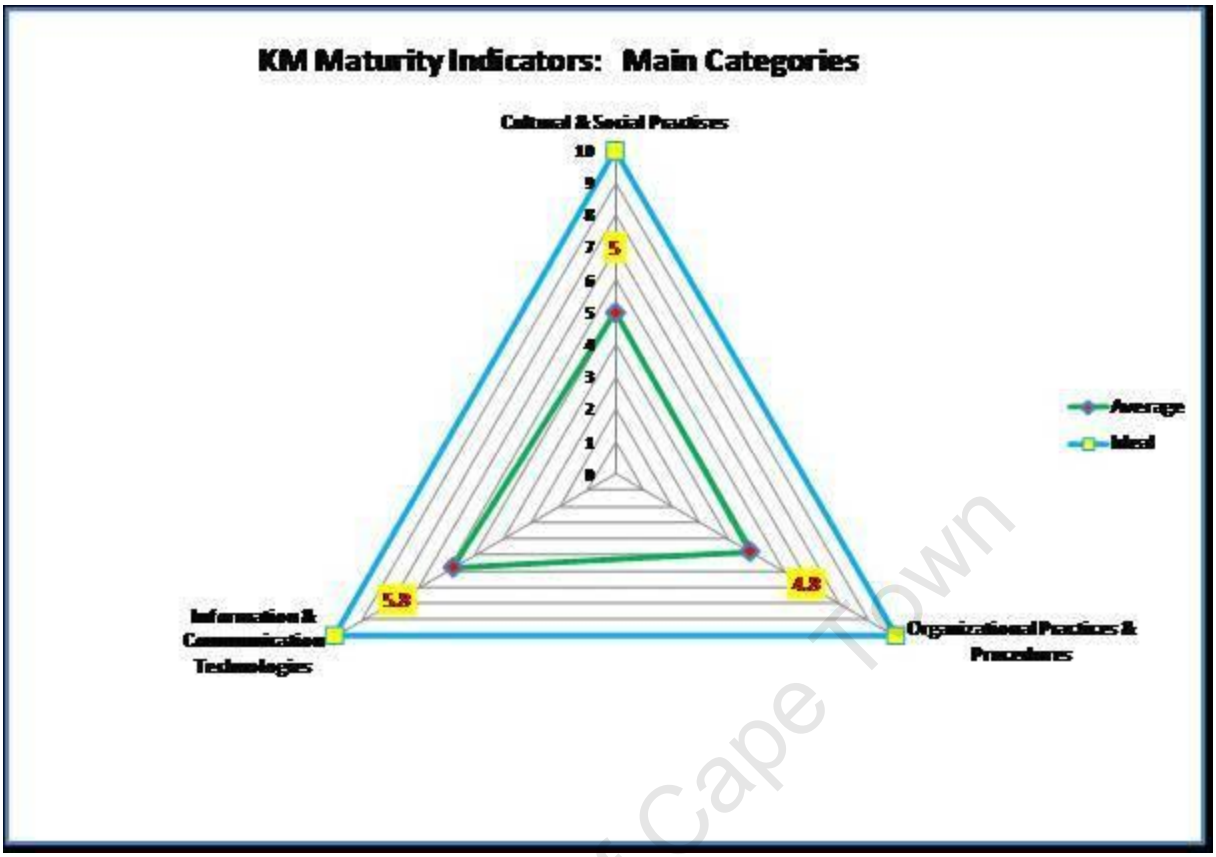

Chart 6.8: Average responses for the three main KM indicators

In the following sections each of the main KM indicators will be discussed in greater detail.

6.4.1. Organizational Structure, Culture and Social Practices

It was seen from the literature that organizations that have a culture that encourages knowledge sharing and creation are transformed into learning organizations and generally have a competitive advantage (cf. chapter 3.2.5). Organizational culture thus plays an important role in shaping the general practices, the values and the norms within an organization. The influence of culture occurs at different levels in an organization and Debowski (2006: 83-84) particularly believes that "organizational cultures strongly influence retention and productivity" as well as how "open individuals are to new concepts and possibilities". Sharing knowledge occurs when

employees are genuinely interested in helping one another develop new capacities for action. It is a culture that should therefore be encouraged to create learning processes.

A critical look at the organizational structure of the CSIR revealed a typical pyramid type of organizational structure with carefully controlled flows of information up and down hierarchies between managers and departments. It is generally believed that such an organizational structure creates barriers to effective practice of KM and knowledge utilization. According to Nonaka and Takeuchi (1995:241), the level of bureaucracy can affect knowledge creation and the flow of knowledge. They state for example that bureaucratic organizations may be ideal for using knowledge, but not for creating knowledge and enhancing its flow; that is, such a structure is more suitable to dealing with explicit rather than tacit knowledge.

To assess organizational structure, culture and social factors at the CSIR, five indicators – knowledge flows, decision-making, innovative ideas, open door policy and experience sharing were measured (cf. question 1- 5, Appendix A). The question on knowledge flow was asked to assess the readiness of employees to disseminate research findings. Every respondent was asked to indicate whether there was a free flow of information and knowledge. "Bureaucracy" was not mentioned in the decision-making question due to the likelihood that it could distort responses. However, a question was asked about the decision-making process in the organization. Questions relating to stimulating innovative ideas and whether an open door policy is followed were also asked. With regard to 'open door policy', the question sought to investigate the freedom of knowledge sharing in the organization - i.e. if there was a practice in the CSIR where employees could approach management with innovative ideas and whether they are encouraged to pursue the idea or otherwise. Lastly, a question on experience sharing was asked to find out if experiences acquired by the employees on the job and through training sessions are shared amongst peers through similar training sessions or through other informal means, e.g. word of mouth.

Table 6.9 and Chart 6.9 below show the results of the analysis of the data collected. The blue line in Chart 6.6 indicates a perfect situation with a score of 10 whereas the red line shows the aggregate score of the responses. Three of the indicators – innovative ideas, open door policy and experience sharing had a below average score of 4.6, 4.8 and 4.8 respectively, while knowledge flow and decision making shows an above average score of 5.1 and 6.1 respectively. The general opinion regarding the KM culture at the CSIR is thus centred round the mid-point or neutral perspective and this indicates that the respondents collectively have a less than satisfactory view with regard to the knowledge management culture.

STRUCTURE, CULTURE & SOCIAL PRACTISES					
Category	Knowledge flows	Decision making	Innovative ideas	Open door policy	Experience sharing
Average	5.1	6.1	4.6	4.8	4.8
Ideal	10	10	10	10	10

Table 6-9: Responses with reference to the organizational structure, culture and social practices

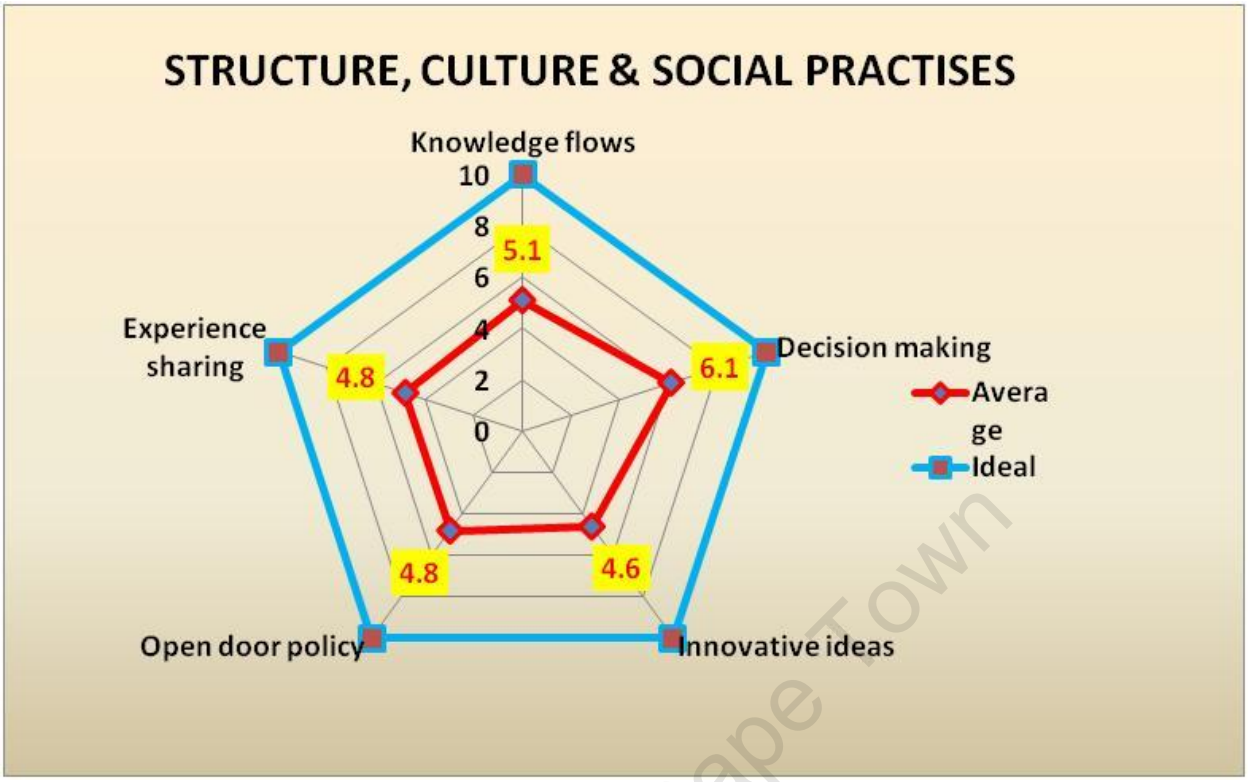

Chart 6-9 Responses plotted to show CSIR's organizational structure, culture and social practices

These results indicate that the existing organizational environment, structure and policies at the CSIR are not really conducive to encouraging employees to innovate and share experience. This is further reinforced by the following response obtained during the interviews:

"I would have wished that when innovative ideas come up, we did not have to wait so long for approval from management before implementing them. It reduces the excitement in new learning". ***CSIR employee***

The top-down organizational structure found at the CSIR is characterized by a command chain that generally produces bureaucracy. Decisions are made at the top and communicated to the bottom for implementation without encouraging any questioning or amendment at the bottom level. This curtails knowledge creation and sharing.

The results from the data analysis further indicate that even though the organization has systems in place to enhance knowledge dissemination, these could be improved upon. This is further reinforced by the following response obtained during the interviews:

"Researchers *are required according to the CSIR policy to share findings of their research with the council through presentations, but this policy is not adhered to strictly. It would be helpful if there was a better platform for knowledge sharing. We have a lot to learn from each other to improve efficiency."* ***CSIR employee***

Currently knowledge sharing takes place by means of informal interactions between individuals, seminars, organized workshops, conferences, and the CSIR research reports. The challenge to the current system is finding ways to improve knowledge sharing between individuals. One interviewee commented on this when he said that:

"We usually share informally by word of mouth. Also we have limited knowledge of what people are interested in at a particular time due to the fact that we are all specialized institutes using technical terms. It is all based on assumptions of what staff need". **CSIR employee**

The current knowledge dissemination activities however focus more on imparting what individuals know and have learnt from training sessions as opposed to learning from each other. Knowledge sharing within the organization is related to the way knowledge flows within the organization and is linked to how individuals perceive themselves and their interactions within the organization.

Further cross tabulation between the dependent and independent variables did not provide any significant results, that is, none of the chi-square tests indicated a p statistic <0.05.

6.4.2. Organizational Practices and Procedures

To determine to what extent organizational procedures and practices are conducive to knowledge management at the CSIR, six indicators were investigated, viz.: whether it was standard practice to report on conferences, etc. attended; the extent to which a procedure of learning from previous work conducted was in place ; whether lack of time and human resources hinders knowledge and information sharing between staff and stakeholders; whether stakeholders have direct communication with the CSIR in order to monitor project performance; whether the organization has systematic databases of all its main work activities that would enable staff and stakeholders to identify expertise and information in the organization; and whether staff who leave the organization go through a systematic debriefing session to capture and record their tacit knowledge to ensure that the organization retains as much as possible of their knowledge and contacts (cf. question 6- 11, Appendix A).

Table 6.10 and Chart 6.10 below indicate the aggregate responses of the respondents regarding the above mentioned organizational procedures pertaining at the CSIR. It can be seen that while four of the indicators represented fair and average scores, two of the indicators, conference reports and projects monitored were below average at respectively 3.7 and 4.5. These two aspects clearly require attention if the CSIR wishes to effectively put in place knowledge management practices to enhance efficiency.

ORGANIZATIONAL PRACTISES & PROCEDURES						
Category	Conference reports	Lessons learnt	Time & sharing	Projects monitored	Systematic database	Staff debriefing
Average	3.7	5.2	6.1	4.5	5	6.3
Ideal	10	10	10	10	10	10

Table 6-10: Responses with reference to organizational practices and procedures

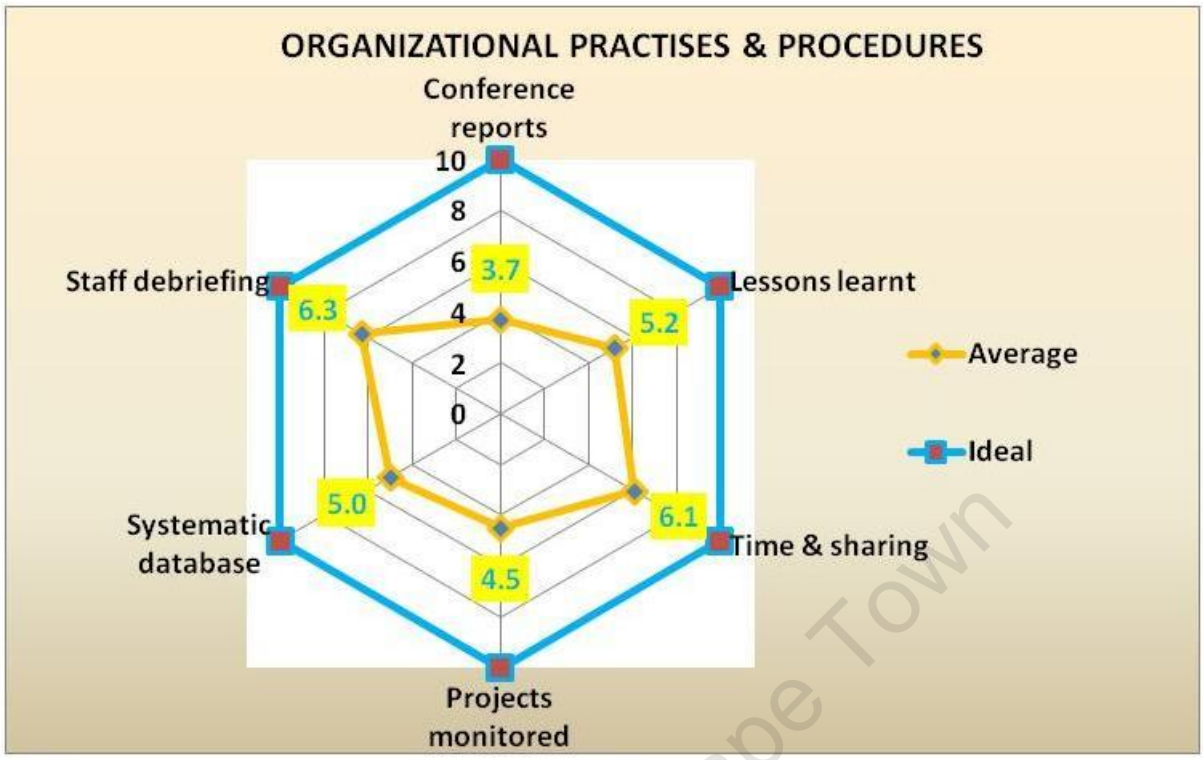

Chart 6-10 indicating the plotted indicators of the organizational practices and procedures

It is strange that such a low score was given for the reporting on conference attendance as it was clear from the interviews that the respondents were generally of the opinion that conference attendance was an important activity as this is where researchers obtain new innovative ideas that they can utilize in their research. Other reasons given during the interviews for why researchers from the CSIR should regularly participate in conferences is that it provides an ideal forum to network with experts in the field, to advertise their research findings and have it evaluated. For these reasons it is clearly important that researchers should report on the conferences they attend to ensure that all researchers are made aware of new innovations globally. It was clear that this view was shared by a number of respondents and one respondent specifically stated during the interviews that:

"As I am mandated to produce a report after each conference I attend … I would wish that the recommendations are evaluated and approved for onward implementation". ***CSIR employee***

The other indicator for which a below average score (4.5) was provided was that of whether stakeholders from external organizations who funded CSIR projects communicated with the organization and monitored the outcome of the projects that had been funded. It is suggested that since the CSIR is a research institution it is important that there is proper monitoring of research findings and implementation of recommendations, otherwise most of the findings may go unnoticed.

The two indicators for which the respondents provided approximately average scores were firstly the one relating to lessons learnt i.e. whether it was standard practice at the CSIR to review research that had been conducted and to learn from the process (5.2). The second was on whether the organization maintained well organized databases containing information on the various experts employed, as well as databases of the main work activities of the organization, e.g. repositories of research findings. Such databases would make it easier for staff or stakeholders to find appropriate information or people with 'know-how' when the need arises. Both these factors are important to ensure effective knowledge management practices and utilization of knowledge and an average score is thus clearly not good enough.

The only two indicators that the respondents felt were being fairly adequately attended to were those of whether the organization provided sufficient time and human resources to enable effective knowledge and information sharing between staff and stakeholders (score of 6.1) and whether the CSIR has an exit interview and staff debriefing mechanism in place (6.3). During such interviews the tacit and explicit knowledge of employees who leave the organization are captured and documented. This ensures that as much knowledge as possible is retained.

These results were further cross tabulated with the independent variables and tested for significance. The only significant differences ($p < 0.05$) were found for cross tabulation between conference reports and position and project monitoring and work orientation. See Chart 6.10.1 below.

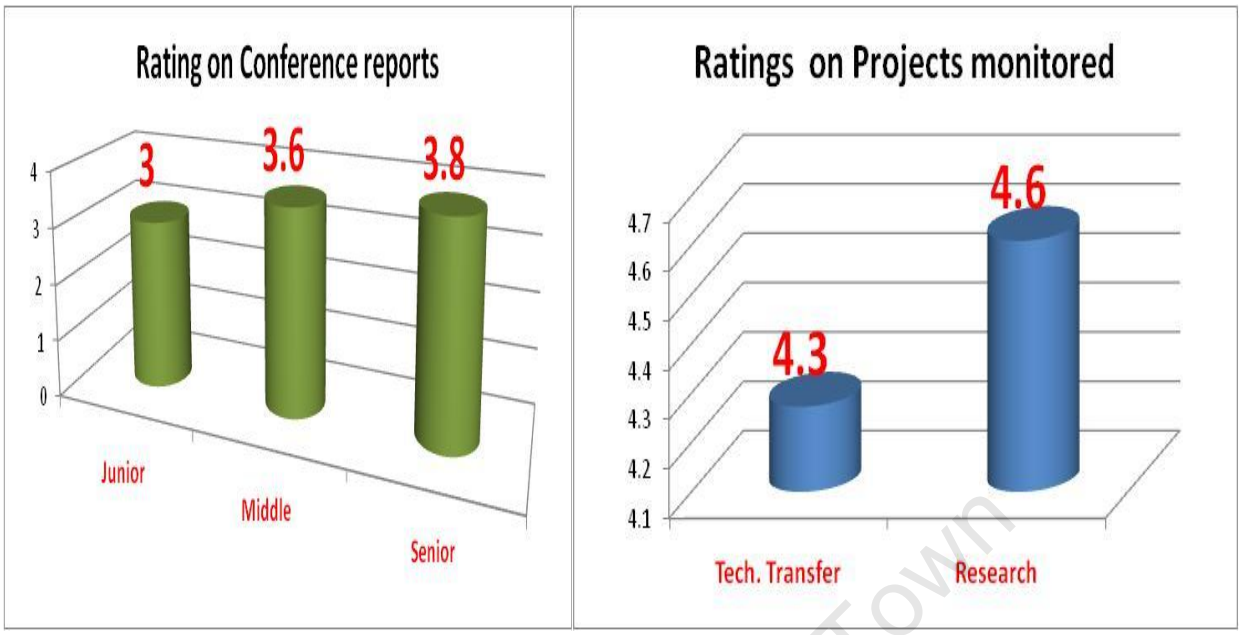

Chart 6-10-1: Indicators showing significant difference in responses

Considering the first cross tabulation, it can be seen that the more senior respondents placed more value on the importance of the production of conference reports than their junior counterparts. This tendency could be related to the assumption that the more senior respondents and thus possibly also the older respondents have realized the knowledge and information sharing value of conference reports that have been produced either by staff internally or externally and that these have stimulated innovations.

It can further be seen that the employees engaged in research held a slightly more positive view relating to whether projects are monitored than their colleagues engaged with technology transfer. The higher values awarded by the researchers to the importance of monitoring projects, can largely be explained by comments made during the interviews where it was stated that by monitoring the progress of projects, results are more readily implemented. Secondly, the higher values could also be attributed to the fact that the research category was more involved with research projects than the technological transfer group.

6.4.3 Information and Communication Technology (ICT)

Information and communication technologies have generally been accepted and recognized as enablers of the processes of knowledge management. The technologies not only enable fast acquisition, storage and retrieval of information, they also provide the virtual platforms for humans to interact. Teece (2000), while cautioning against a technology-centered knowledge management approach, have argued that a basic technology infrastructure is a necessary component for successful knowledge management projects. Although a successful knowledge management programme involves more than merely deploying the best information technology products available in the market, it is however important to embrace information technology as an enabler and facilitator of the process. Because of the role that information technology can play in knowledge management, it is thus essential to invest in basic information technology infrastructures when setting up a knowledge management programme.

To determine to what extent the information and communication technologies that are being employed at the CSIR can effectively be used for knowledge management purposes, four indicators were investigated, viz.:

- whether there was an adequate ICT platform in place;
- whether the ICT was being effectively deployed;
- whether relevant information was being captured on the CSIR network and the various institutional portals and then made available to employees; and
- Whether interactive tools such as Skype, groupware, Google docs, etc. were being employed to ensure timely and inexpensive communication and sharing of knowledge across the organization. (cf. question 12- 15, Appendix A).

Table 6.11 and Chart 6.11 below indicate the average scores relating to the utilization of information communication technology to drive Knowledge Management initiatives. They range from average scores for the adequacy of the IT platform (5.4) and making information

available (5.5) to fairly good scores for the availability of interactive tools (6.0) and the satisfactory level of ICT (6.2).

INFORMATION & COMMUNICATION TECHNOLOGIES				
Category	Adequate ICT platform	ICT good	Information available	Interactive tools
Average	5.4	6.2	5.5	6
Ideal	10	10	10	10

Table 6-11: Indicating the varying responses of ICT in CSIR

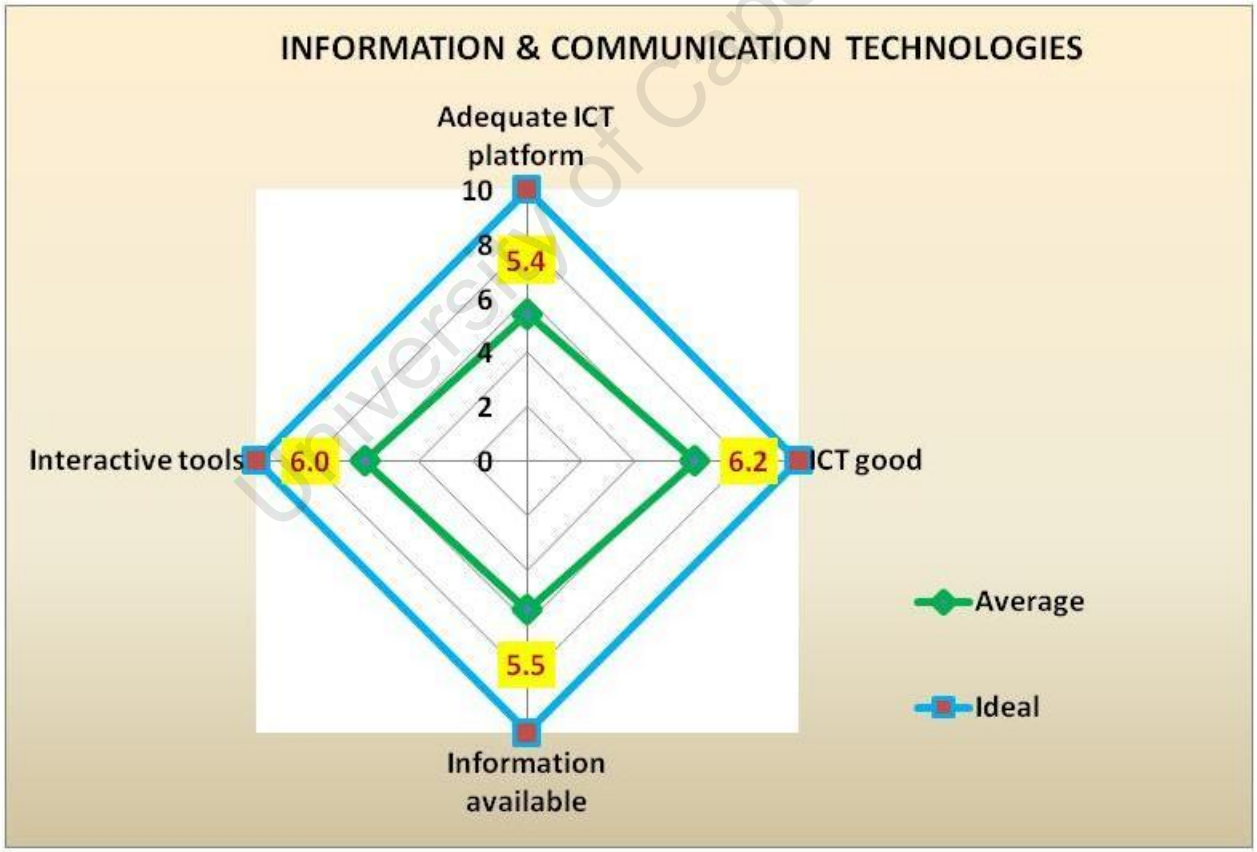

Chart 6-11: Indicating the plotted indicators of information & communication technology (ICT)

Information technology provides the platform and tools that can reduce duplication of effort, increase the ability of individuals to share and communicate through networking by means of, for example, email systems. The data collected by means of the questionnaires as well as the interviews suggest that the CSIR has an adequate technology infrastructure that has the potential to enhance and enable knowledge management activities such as the effective sharing and dissemination of information and knowledge both within the organization and to the broader community of CSIR stakeholders.

For example, the organization has full access to and use of the internet and email services , the staff can access a range of databases such as online research databases in institutions worldwide such as (http://regional.bvsalud.org/php/index.php), JSTOR (Scholarly journal archive database), and many others that offer full text research articles. However, despite the fairly good technology infrastructure, a number of respondents did identify many problems relating to their interaction with the current system. The most significant of these were the respondent's assessment of their expertise in finding useful information. The following quotations emphasize these aspects:

"It would be helpful if in addition to the various databases out there, the institute could provide us with an online directory of experts in our various fields, this would reduce time and cost moving round in search for experts". ***CSIR employee***

"As a researcher, I am mostly on missions, it would be helpful if there were more sophisticated technologies for communication such as video conference equipments, to aid us to participate in major meetings both internally and externally, this would improve our work, and get knowledge across in real time". ***CSIR employee***

The researchers thus are of the opinion that even though the CSIR seems to have a fairly good ICT infrastructure, the ideal situation has not yet been attained. Further cross tabulation between the dependent and independent variables did not provide any significant results, that is, none of the chi-square tests were <0.05.

6.5 Barriers to Knowledge Management in the organization

The researcher asked the respondents what, in their opinion, was hindering the free flow of knowledge in the organization (cf. question 16 Appendix A). This was an open-ended question which the researcher thought would give the respondents the opportunity to express themselves without being restricted by any prearranged closed-ended answer categories.

The respondents were mostly concerned about the following:

- The rivalry that often exists between researchers competing for funds and projects make them less willing to share results, findings and procedures.
- The CSIR has 13 institutes each specializing in different areas and because of this diversity it is difficult for knowledge sharing across boundaries as topics might not be relevant to researchers in different institutes.
- Institutes are geographically scattered, thus they become isolated and they then tend to form their own empires and are not willing to share knowledge and information.
- There is no leadership incentive to encourage knowledge sharing.

6.6 Improvement of Knowledge Management in the organization

Finally, the researcher asked respondents to propose methods and enablers that would promote the access to knowledge in the CSIR and its institutes (cf. question 17 Appendix A). This was yet another open-ended question and the researcher did not expect any fixed answers from the respondents. Not many suggestions were provided but the few that were indicated can be summarized as follows:

The need to

- Ensure continuous training of staff,

- acquire modern ICT equipment such as video conferencing equipment to enhance knowledge sharing,
- solicit the services of specialists in knowledge management, to help utilize appropriate KM tools to improve efficiency,
- improve library facilities,
- Change the attitude of top management and to ensure that they appreciate the value of knowledge management, encourage the implementation of innovative ideas and to provide more open forums to display innovative ideas.

6.7 Conclusion

The data collected were categorized, summarized and presented in tables and charts. Analyzed data indicated that the implementation of KM practices is necessary to improve the flow of knowledge within the CSIR and that the CSIR was still at a very basic maturity level in its practice of knowledge management. In the next chapter, the findings of the study will be discussed, conclusions drawn and a roadmap will be provided to indicate how KM could be implemented and recommendations made.

7.0 CHAPTER 7: DISCUSSION OF FINDINGS, ROAD MAP, RECOMMENDATIONS AND CONCLUSION

This chapter contains a discussion of the findings, recommendations and the conclusion of the study. Issues that arose from the results of the data that were presented in the previous chapter are discussed in this chapter

7.1 Introduction

This chapter contains a discussion of the findings, recommendations and the conclusion of the study. Issues and perspectives that arose from the findings that were presented in the previous chapter (six) are discussed within the broad framework of this study, i.e to investigate how knowledge is shared within Ghana's CSIR and with other stakeholders in order to increase the quality of products and services, and promote innovations (cf. section 1.6).

This project thus sets out to map knowledge and information flows of the organization and in the process identify gaps in the current knowledge and information environment. An outcome of this chapter will be to make recommendations regarding knowledge management implementation and to propose a knowledge management best practice model and strategy for the CSIR.

7.2 Discussion of Findings

The findings will be discussed following the same structure as in chapter 6.

7.2.1 Population Profile

An outline of the study population was obtained. The respondents were fairly equally distributed amongst eight of the thirteen research institutes and the majority (56%) were in the middle age bracket (31-50 years). As was mentioned previously (cf. chap 6.3.2), the study was purposely constituted in such a way that the majority of the respondents were researchers and

because researchers in the CSIR generally hold more senior positions it was also found that the majority of the respondents were in the more senior position category (cf. chapter 6.3).
More than two thirds (71%) of the respondents were male. The reason for the low female percentage probably relates to the fact that in Ghana men predominate in the fields of science and applied science and this would then also be reflected in the work situation at the CSIR. The researcher is of the view that the CSIR should address this issue of disparity - she agrees with Sveiby (2001) that the balancing of gender in an organization should be seen as a planning issue.

The fact that the majority of the respondents held either a PhD (49%) or Masters degree (29.0%) suggests that the CSIR has the ability to process information and achieve success. This line of reasoning is based on Sveiby's (2001) argument that the educational level of the professionals that are employed in an organization can be linked to their level of competence and this in turn affects the organization's ability to achieve future success. Sveiby further argues that the level of formal education is a good predictor of an individual's ability to effectively process knowledge and information - by extension, the more employees that an organization has with higher academic qualifications the greater its ability to process vast amounts of information

7.2.2 Key Knowledge Management Indicators

The discussion of the responses with regard to the KM maturity levels of the organization are outlined using the categorization that the researcher employed for the empirical component of study viz.: the interrelationship between organizational structure, cultural and social practices and KM; organizational procedures and practices and KM; and information and communication technology and KM.

The first category relates to the organization's work environment whilst the latter two are concerned with components that relate more directly to knowledge management processes and a KM initiative (cf. also chapter 6.4).

Fifteen knowledge management indicators were used within these three categories to establish the level of KM maturity in the CSIR (cf. chapter 6.4.1 and Appendix A., Sections 2-4). It was seen from the analysis that most of the indicators hovered around the midpoint (5.0 out of a total score of 10.0); some went slightly above with the highest score reaching 6.0; while a few were below the midpoint with the lowest score at 3.7. In the following sections the findings will be discussed in greater detail.

7.2.2.1 Organizational Structure, Cultural and Social Practices

Within this category five KM indicators were used to measure the organizational structure, cultural and social practices. It was seen in chapter 6.4.1 that the CSIR's hierarchical structure impeded the free flow of knowledge in the organization and thus inhibited effective knowledge management. It was evident that the overall structure influences a number of the key functions of the CSIR. For example the institutes cannot implement any major research finding or purchase any information technology infrastructure without the approval of the management of the council. Some of the interviewees stated that if the various institutes were allowed more independence and were less constrained to operate within a rigid structure, they would have more flexibility to innovate and implement knowledge management and new information technologies. The CSIR's organizational environment clearly did not promote knowledge sharing and innovation - employees were not encouraged to share experiences and the management was not good at articulating and communicating new innovative ideas from the various institutes to the entire staff body.

The researcher suggests that to overcome many of the problems highlighted above and to ensure an effective operational KM programme the CSIR should implement the following:

- The goals and objectives of the organization need to be understood and incorporated into a knowledge management strategy for the CSIR.
- Management should regularly evaluate and approve researchers' relevant innovative ideas and share these ideas with all the employees for onward implementation.

- Employees should be given the opportunity to freely approach management with new ideas and training sessions that would improve the work in the organization.

This would suggest to employees that management is committed to seeing that the organization moves forward to fulfilling its vision and mission. This would further encourage and motivate employees to develop their individual work plans to fit in with the overall organizational aims, and objectives.

The researcher suggests that by developing a culture in which individuals are made to realize that they are valuable members of the institution, by making employees part of the decision-making process, by creating good communication structures and encouraging knowledge exchange the practice of KM would be encouraged and this would in turn translate into an overall benefit for the organization. Culture is displayed in the way organizations conduct their day to day activities and a number of these aspects were identified during the study. For example it was demonstrated by the way the different research institutions communicated with each other. Even where employees belonged to the same institute, individuals seemed to work independently. One interviewee, for example, commented that researchers work more to benefit themselves than to make an organization-wide contribution.

From the literature (cf. chapter 3.2.5) it was seen that organizational culture has to be built on trust which again fosters team work and knowledge management initiatives. Lynd and Lynd (1957:28) has further suggested that such a healthy culture is a key factor that will help an organization to win in the market place. Likewise, a management style that is flexible to innovative ideas facilitates learning and provides room for building trust and this in turn would strengthen the success of knowledge management and move the CSIR to greater success.

In summary it can be seen that it is evident that the current organizational culture at the CSIR is not fostering collaboration and knowledge sharing. The CSIR management thus has a major task to clearly define and communicate the organizational vision and mission and also to make their

expectations for the organization clear so that they can develop a culture that is meaningful and which enhances the objectives of the organization.

7.2.2.2 Organizational Practices and Procedures

Six indicators were used to measure the organizational practices and procedures of the CSIR with regard to acquiring and disseminating knowledge. It was seen in chapter 6.4.2 that the overall aggregate score for these indicators was below average (4.8) and it is thus clear that the organizational practices and procedures that are presently in place are not particularly conducive to promoting knowledge management. The indicators for which the responses were the lowest were those relating to reporting on conferences attended and the monitoring of projects.

A number of respondent were, however, of the opinion that because the CSIR was a research institute a very large proportion of the activities in the organization were by nature knowledge-oriented even though not explicitly structured as knowledge management activities. It was further promising to note that all the respondents with whom the researcher had discussed the principles of KM indicated that they could see how beneficial it would be to them if the CSIR were to implement KM in a more structured way. Wiig (1997) argues that without a structure it is difficult to help interested and motivated organizational members to build a coherent overview of the important aspects of knowledge that are needed to "wrap my arms around it." More importantly, without a framework (cf chapter 4) it is almost impossible to help others who have not yet had an opportunity to discover the importance of knowledge to understand the need to pursue knowledge management.

The researcher thus suggests that the CSIR should more systematically engage with knowledge management and more specifically encourage all employees to actively engage with the dissemination of knowledge. She proposes that to start the process the CSIR can expand on efforts they are already to a limited extent involved with. For example they should be more pro-active in organizing workshops wherein innovative ideas are shared, mandate all

employees to report on conferences they attend and it should further become standard procedure to monitor all projects.

In summary, it is clear that planned knowledge management practices are at the early stages of being accepted and adopted and the view that knowledge should be managed as any other organizational resource is yet to be fully embraced at the CSIR. Knowledge is yet to be seen as an important input to strategic decision-making and it is thus argued that a concerted effort should be made to embed knowledge management in the day-to-day activities of the employees and the organizational procedures and practices of the CSIR.

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7.2.2.3 Information and Communication Technology (ICT)

"Information and communication technology (ICT) constitutes an integral part of communication because it is the medium that generates processes, communicates, transfers, and visualizes data and information. Without appropriate IT to communicate trustworthiness, trust building in organizations is compromised and this affects knowledge sharing". (Kasper-Fuehrera and Ashkanasy, 2001).

Four KM indicators were used to measure the information and communication technology category. The information and communication technologies that were available at the CSIR ranged from basic technologies such as telephones and fax machines to computers. It was seen in chapter 6.4.3 that although the CSIR has a basic technology infrastructure that could be better used to enhance and enable knowledge management activities it is also not sufficiently up-to-date and technically advanced for the most effective deployment of knowledge management.

The researcher is of the opinion that even though the findings show that the average for the ICT category (at 5.8) is the highest of the three main KM maturity indicators (cf. 6.4) and that sixty percent of the respondents indicated that the organization had interactive tools that help in managing knowledge, much still needs to be done to improve the ICT infrastructure and the

utilization thereof. For example, many respondents expressed the view during the interviews that the technologies that are available are outdated and/or sorely in need of maintenance and could not be relied upon to provide an effective ICT platform for knowledge management. The researcher further observed that not every employee had a computer and even where they did have one, they did not all have access to the internet on a daily basis and those that had access also faced the challenge of power cuts. It was also noticed that access to the internet often depended on seniority and an employee's influence in the organization.

It is suggested that to more effectively enable KM activities the CSIR should improve its ICT facilities by, for example, acquiring access to the Internet, Skype and purchasing video conferencing equipment. These facilities would be particularly beneficial to staff who are travelling and who wish to interact with their colleagues and wish to transfer knowledge.

The researcher observed from discussions with senior management that while some of them were under the impression that the technologies required for knowledge management were very costly and that CSIR would not be able to afford such technologies, others again thought that the CSIR's current information and communication technologies would be sufficient to support basic knowledge management processes. There is, therefore, the need to convince staff and management of the benefits that can be derived from more advanced ICT tools, particularly in a knowledge-oriented organization like the CSIR, and also to indicate how such innovation can affordably be achieved.

It is evident that while advanced ICT tools have not been utilized in the organization, the organization currently does have basic repositories in which available information and knowledge are being kept. The type of knowledge stored includes

- informal and internal knowledge that the employees share amongst themselves
- structured internal knowledge, which comprises of the contact databases and the research findings which have been documented
- structured knowledge acquired from the external sources.

Availability and the fact that these types of knowledge are being stored in databases is a demonstration of the fact that the absence of advanced technology-based knowledge management tools does not necessarily mean the total absence of knowledge management in the organization. The only problem is that the absence of advanced knowledge management technologies restricts fast acquisition, processing, sharing and transfer of large quantities of knowledge and information.

It is therefore argued that to ensure effective knowledge management implementation the CSIR should urgently invest in and acquire modern computer-based technologies for this purpose. It is further, however, clear that the organization is not fully aware of the extent of the benefits that the investment and utilization of advanced technologies would have for the organization.

Velden (2002), for example, has argued that ICT offers the tools and facilities to capture data, information and knowledge, as well as alternative scenarios that support online communities of practice which in turn helps making information and knowledge more accessible. The capturing of knowledge in formats that can easily be stored and retrieved relies heavily on information systems such as databases, expert systems, corporate portals, digital directories, all of which are only possible if appropriate technology is applied. ICT has clearly established itself as an important tool that enhances communication and knowledge exchange between people and it is thus also a powerful and necessary enabler for effective knowledge management.

7.2.3 Summary of the Discussion of the Findings

To recapitulate, the research project investigated the extent to which knowledge management is practiced at the CSIR, an agricultural research institute in Ghana. It thus sought to discover whether the organization had appropriate mechanism in place to gather, utilize and derive benefit from knowledge, both tacit and explicit, created within the institution, or imported from external sources. The results of the study clearly show that although the CSIR is

undoubtedly a knowledge and information rich organization - both in the use and generation thereof – the institutionalization of knowledge management is still very much in its infancy.

The study further highlighted that the adoption of KM is indeed a complex process involving not only the implementation of appropriate information communication technologies but also a change in mindset with regard to the organization's culture, social orientation and its internal procedures and practices. It is further evident that the benefits that can be derived from embedding KM throughout the CSIR would be considerable. KM processes would create the right environment for the organization to continually create, store, distribute and apply both existing and newly-acquired knowledge. This, in turn, would lead to increased innovation, effectiveness and productivity.

It is; however, clear that a number of issues would first have to be resolved before knowledge management could be effectively implemented throughout the CSIR. For example, a concerted effort should be made to ensure congruency between KM processes and organizational objectives and stakeholders' expectations. Employees should be made part of the procedure and made to realize that all KM activities are about tacit and explicit knowledge conversion (cf. Nonaka, 1994) and that appropriate KM practices should be embedded in all organizational processes. All employees must further be made aware of the benefit of employing ICT-based KM initiatives and informed of the most appropriate ICT functions that would best apply to KM at the CSIR.

It is clear that although certain KM-related activities and knowledge work is already in place much needs to be done to enhance them. The fact that the CSIR is a research organization with thirteen different institutes each specializing in a distinct area of expertise, means that the most important knowledge asset that the CSIR has is its research staff, many of whom are known experts in their field. They all produce research reports and therein resides a very valuable knowledge asset and organizational knowledge base if properly organised and disseminated.

The CSIR's management should therefore more pro-actively inculcate a knowledge-oriented attitude and develop clear KM policies to guide and embed KM activities. Activities that, for example, could fruitfully be explored and given attention to are

- the more general and wider dissemination of all research reports produced
- expanding on the existing culture of encouraging employees to regularly attend conferences and training workshops (both internal and external)
- making it a requirement that all employees who attend such activities report on the experience by either disseminating written reports to as wide an audience as possible, or by work-shopping their experience with their colleagues who were not able to attend
- fostering networking and collaborative relationships
- better utilization of the existing ICT infrastructure for KM purposes and further investigating how it can be improved

The organization, however, faces several challenges and problems in managing knowledge - some of these are not unique to Ghana and occur worldwide, other are again specific to the Ghanaian organizational environment. The most pressing concerns facing the CSIR are

- the lack of understanding of the value of knowledge and little top management support for knowledge management,
- the lack of standards and criteria for measuring the value of knowledge management,
- the difficulty of establishing a knowledge-friendly culture,
- technological and other impediments to accessing knowledge in the CSIR,
- and most significantly the lack of an active knowledge sharing culture.

The researcher further suggests that implementing knowledge management across all processes and divisions in the CSIR need not be a complicated, overly technology-based and costly process. The CSIR currently has fairly adequate resources and a number of knowledge-related operations that can be expanded and built on to fully implement KM. Embedding

knowledge management throughout the CSIR clearly holds many benefits for both the organization in general and all individual employees. Better knowledge management will assist the organization to stimulate and encourage the creation of new knowledge, to better understand how to acquire knowledge, how to process, interpret, modify and use knowledge, how to store and preserve knowledge, how to disseminate knowledge and how to share knowledge and expertise. It would help them to retain and lever valuable tacit knowledge and create a more motivated workforce that values and capitalizes on knowledge more effectively. All these factors will most certainly enable the CSIR to attain greater excellence and provide superior research findings to the Ghanaian citizenry.

In summary, the researcher would like to express the hope that this study will encourage managers at the CSIR to not only manage organizational knowledge more efficiently, but also to take cognizance of current organizational knowledge management research practices. Also that it will provide the impetus for the CSIR and all organizations in Ghana to encourage research on the management of organizational knowledge for innovation in Ghana.

7.3 Answering the Research Questions

The researcher, having provided an overview and discussion of the most significant findings and issues addressed by this research project will now outline the extent to which the research questions that served as the framework for the study have been resolved or not.

Research Question 1: Are the cultural and social practices at the CSIR conducive to knowledge management and the generation, acquisition, use and sharing of knowledge?

The respondents returned a score at the midpoint (5) for these factors and it is thus clear that much still needs to be done regarding the CSIR's cultural and social practices for it to fully embrace knowledge management. Employees in the CSIR are not accountable to anybody regarding the creation of new knowledge, processing knowledge, preserving it and sharing it with other employees or the various institutes.

However on the positive side, all researchers at the CSIR as part of their research endeavors do have to acquire new knowledge and share their findings with others and other departments (albeit in an unstructured way). It was further seen that employees do participate in internal and external training sessions, thus enabling them to acquire new skills, new knowledge and new capabilities.

The researcher, having taken note of both the positive and negative factors relating to the CSIR's cultural and social practices that impact on KM, concludes that the organization faces a number of challenges and problems that it would have to resolve before it can effectively implement a full knowledge management programme that stimulates knowledge creation, use and dissemination. Major among the challenges and impediments is the lack of awareness regarding the benefits of knowledge management; the environment in which the organization operates, e.g. the lack of trust and secrecy between employees and the fact that the creation and sharing of knowledge is not prioritized and fully emphasized.

Research Question 2: Are the CSIR's organizational practises and procedures assisting or inhibiting the interaction with knowledge and the practice of knowledge management?

The overall scoring for whether the CSIR's organizational practises and procedures were assisting knowledge management was the lowest of all the scores given to the various KM indicators. These aspects clearly require the most attention to bring them in line with good KM practice.

It is clear that a number of the CSIR's organizational practises and procedures inhibit the interaction with knowledge and thus create barriers to the full implementation of knowledge management. It was seen, amongst others, that the organizational structure is overly hierarchical and that there was little support from management to engage with KM procedures.

The CSIR, however, does make an effort to store information resources that it acquires in various organizational repositories. Typical examples of the information that is captured is

information obtained from conferences and training sessions, the organization's annual reports and information and knowledge acquired by individual employees. The main knowledge asset of the organization however is its employees, many of whom are experts of high repute in their fields of specialization.

It can thus be concluded that the CSIR would have to seriously review its organizational practices and procedures if it wishes to put in place an effective knowledge management programme. The one encouraging aspect is the availability of the various knowledge and information repositories.

Research Question 3: Does the CSIR have an adequate information communication technology platform that is utilized to leverage knowledge management practices?

The study indicated that, although the ICT category obtained the highest aggregate score (5.8) of all the KM indicator categories, the ICT platform at the CSIR is not sufficiently advanced or geared to KM to provide the full range of features ideally required for a knowledge management programme. It is further clear that employees were not fully using the current ICT tools for knowledge management related applications.

It is argued that if the CSIR were to enhance its ICT platform to more adequately meet the needs of a knowledge management programme and if employees are encouraged to more actively use ICT tools, the implementation and use of knowledge management would be promoted.

In conclusion it can be stated with regard to the three research questions that formed the basis of this research project that, although there are a number of positive indicators of the underlying application of knowledge-related activities at the CSIR, much still needs to be done to fully implement knowledge management.

7.4 Recommendations

Following on the discussion of the research questions in the previous section, the researcher would like to put forward a number of recommendations that she argues could be used to guide the CSIR to move towards implementing a more structured knowledge management approach.

7.4.1 Incorporating Knowledge Management Practices

It is recommended that the CSIR effectively integrates knowledge management in its organizational procedures and that essential knowledge is routinely disseminated to all employees. Management should not only facilitate the sharing of such knowledge within the organization, but also with all stakeholders who contribute to research projects. Employees should be encouraged to contribute to the objectives of the organization by more actively engaging with knowledge. Sharing of knowledge should be linked to performance evaluation and promotions as this would demonstrate to employees that participating in the practice of knowledge management is an important component of their jobs. It should further be explained that this would also enhance personal development.

Learning and training programmes create important sources of new knowledge, capabilities and skills. It is further recommended that the organization should make a concerted effort to increase training programmes for its employees and provide more assistance to attend conferences. By providing more such opportunities, the CSIR would be promoting a learning culture that would not only enhance the capabilities of all employees, but also improve the organization's effectiveness, performance, and its ability to keep up-to-date with developments elsewhere in the world. The organization should further insist that employees share what they have learned with their colleagues and that newly acquired knowledge is actively used in the work environment.

7.4.2 Creating Knowledge Profiles and Expertise Locators

As a research organization with 13 different institutes, there is a wealth of expertise available within the CSIR. For example, the majority of the research staff hold advanced qualifications (i.e. a Masters or PHD degree) and many of them are well-known experts in their fields. The non-research employees also have extensive specialized expertise. However, the extent of the expertise available in the organization is not well known as the organization does not conduct knowledge audits to establish who has what kind of expertise and how such expertise may be used gainfully. Management should thus be made aware of the need to document and update the expertise in the organization as well that of external experts who have worked with employees, i.e. create a 'knowledge yellow pages'. By creating such knowledge profiles the CSIR can avoid duplication of effort, identify the strengths of staff members and highlight gaps in the knowledge base.

7.4.3 Changing the Organizational Culture and Management Procedures

It is clear that the organizational culture and management procedures in CSIR are not sufficiently supportive of knowledge management and it is thus recommended that these issues should be addressed. The senior management could, for example

- develop the leadership potential of all staff,
- allocate specific resources to initiate a knowledge management programme,
- embed a culture of knowledge creation and sharing in the organization,
- encourage and nurture learning, independent thinking and innovation among all employees.

The CSIR practices a top-bottom problem solving management style where typically senior management do not delegate authority or creative work to lower levels. With such an approach, knowledge management may be regarded as an area only for the more senior staff – for example staff in the lower levels are generally denied the opportunity to create knowledge, share knowledge and have access to the knowledge held by their more senior counterparts. It is recommended that the organization should move to a more equalized management style and

give each employee an equal chance to contribute to problem solving and other knowledge-related activities.

7.4.4. Implementing Enhanced Information and Communication Technologies (ICT)

Although it was seen that the ICT at the CSIR is regarded as being slightly above average, it is also clear that the information and communication technologies at the CSIR are fairly basic. Many knowledge management practices can be enhanced if supported by a good ICT platform. It is thus recommended that the CSIR should invest in and utilize ICT tools that are more aimed at knowledge management applications. For example, the use of such tools would

- improve communication; e.g. video conferencing would particularly assist researchers who are travelling in Ghana and abroad
- enhance knowledge creation and sharing
- help the CSIR to transfer knowledge more rapidly
- support collaboration
- assist with the codification of knowledge management strategies.

Lack of advanced knowledge management technologies (that are generally also very costly) should however not necessarily mean that knowledge cannot be managed in the CSIR. In the absence of advanced ICT tools, the organization may then decide to rather place more emphasis on using non-technology based KM techniques to assist with creating, sharing and storing knowledge.

7.5 Knowledge Management Roadmap for the CSIR

In this section the researcher proposes a roadmap that the CSIR could adopt to effectively initiate and implement knowledge management and strengthen its knowledge assets. It has clearly emerged from this investigation that even though the CSIR's management acknowledges the potential advantage that the more effective leveraging of knowledge holds for the organization, there is still a lot that needs to be done - for example an urgent need to develop

well integrated knowledge management strategies and practices that will focus on knowledge as a key asset. Knowledge resides in the human mind and there is therefore a need to stimulate mental processes and create an organizational culture that provides opportunities for individuals to share interact and develop their knowledge capabilities. A further important factor that has to be taken into consideration is that there should be a synergistic integration of technology, people and work processes in the KM strategy that the CSIR adopts.

The road map that is outlined below indicates the actions that the CSIR should focus on in order to improve the practice of knowledge management. It is based on the results from the study and valuable input from the knowledge management literature. . Figure 7.1 below provides a graphic outline and structure of the proposed road map.

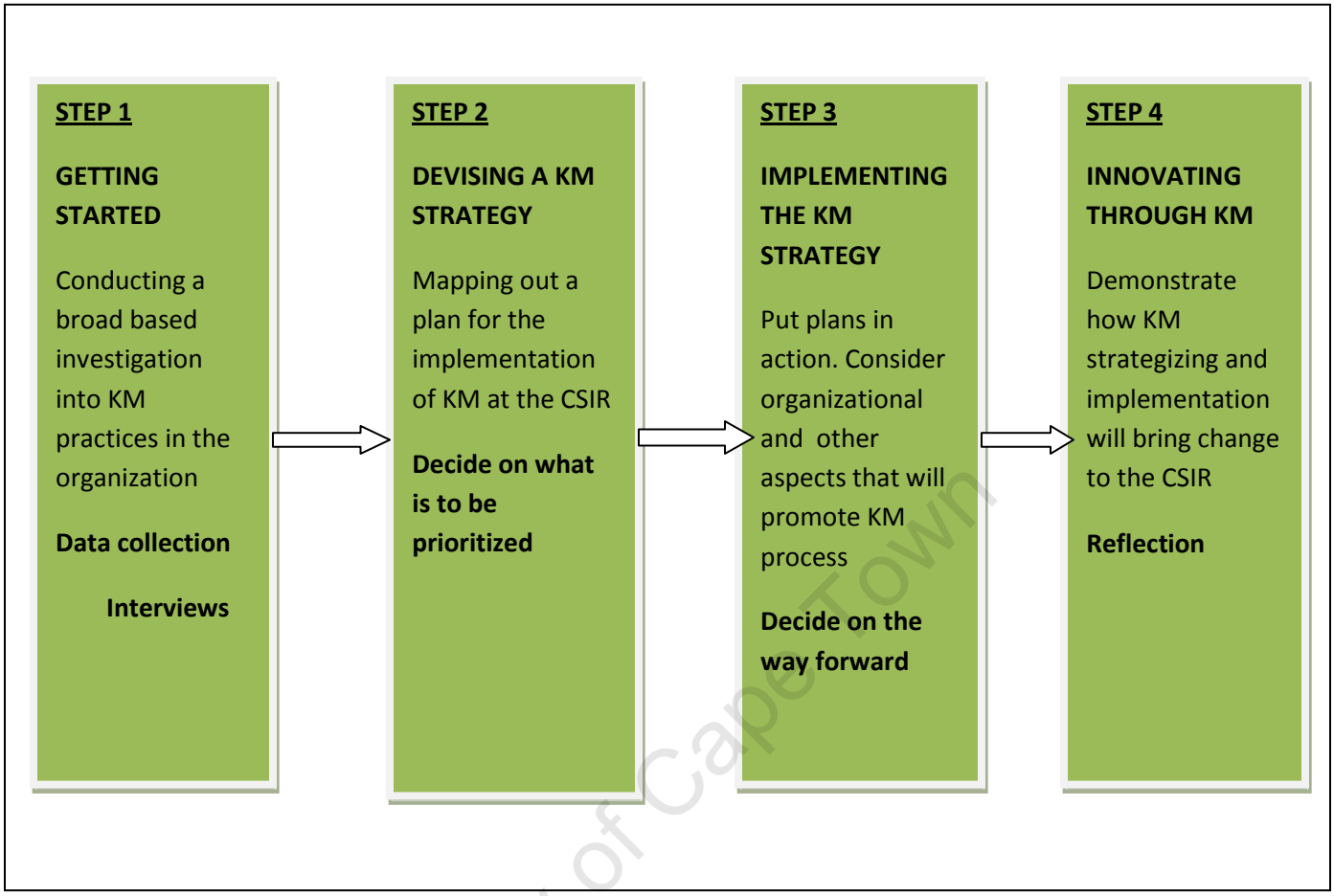

FIGURE 7-1: A Road map for knowledge management implementation at the CSIR. Source: author

The KM structure depicted in figure 7.1 above represents a high-level framework that it is suggested can be utilized to systematically improve KM activities at the CSIR. It is, however, important to note that although the respondents in the study never explicitly stated that knowledge management is practiced at the CSIR, the findings clearly indicate that certain knowledge management related initiatives are already taking place. It is further clear that these practices can be improved on to create greater efficiency in work processes. In the following sections further detail is provided regarding the main activities and key aspects that it is recommended the CSIR should focus on to implement a fully functional knowledge management programme.

7.5.1. Getting started

The first step outlined in the roadmap is the process to be followed to initiate the KM programme. This relates to gathering data to

- establish the CSIR's knowledge needs;
- ascertain the current situation with regard to the extent to which KM is already being practiced;
- create an inventory of knowledge and information resources;
- identify knowledge gaps, and
- discover the major impediments that would hinder KM implementation as well as factors that would assist the process.

This research project has already covered certain of these aspects, viz. it has investigated selected knowledge management (KM) practices in the organization by conducting interviews with a sample of the staff. This has helped to establish whether any the knowledge management related practices are already taking place, their effectiveness and what steps could be taken to improve on such practices. A more in-depth and broad based investigation is now needed to cover the aspects mentioned above.

7.5.2 Devising a KM Strategy for the CSIR

To implement the process outlined in the road map the next crucial stage would be to devise a knowledge management strategy. Such a KM strategy provides a clear framework and direction for an organization to engage in a structured approach to the creation, collection, organization and distribution of knowledge. Such a culture is very dependent on how the employees interact with each other, on their interpersonal trust and on management support – all of these factors would impact on their willingness to share knowledge. The researcher suggests that Heisig's (2001, 2009) framework (cf chapter 4.6) would provide a good model to assist in developing an appropriate knowledge management strategy for the CSIR. She thus proposes that the following four main KM strategies that are highlighted in the framework could suitably be applied at the CSIR:

- **Knowledge Creation processes**

  An important requirement is to first determine what knowledge is generated in the organization, e.g. knowledge generated during project research and reported in research findings, etc. The organization should then create additional platforms and the right environment to further stimulate new knowledge generation and subsequent innovation, e.g. providing training sessions to acquire and disseminate knowledge relevant to the CSIR; encouraging conference attendance to bring in external knowledge to the organization, etc.

- **Knowledge Storage**

  The second strategy component would focus on creating adequate knowledge repositories that can effectively capture all knowledge (explicit and tacit, internally created and externally acquired) that is of importance to the organization. Where appropriate, relevant information and communication technologies such as, electronic databases, Wikis, the organization's website, etc. could be employed (Choi and Lee, 2002).

- **Knowledge Distribution**

  The next strategy component would relate to ensuring that newly-acquired knowledge is effectively distributed amongst the organization's employees. There are two possible approaches that can be followed either independently or in conjunction. Firstly, information communication technologies such as wiki pages, portals, websites, etc. can be used as the vehicle to distribute knowledge amongst the CSIR employees. Secondly, a human strategy that provides the means, space and time for employees to interact can be adopted. For example the organization could implement more training sessions to enable knowledge sharing, encourage the establishment of communities of practice, or any other such interacting forum.

- **Knowledge Application**

  The final strategy component and probably the most important and often difficult one to implement would relate to encouraging employees to apply and use the knowledge

generated and acquired by means of the various strategies outlined above. The CSIR clearly fits Castells' (2000) characterization of an organization working in the knowledge economy and for that reason it is of utmost importance that knowledge generated, acquired and exchanged is used effectively to enhance the innovation process in the organization. Many scholars have argued that effective KM knowledge management practices ensure that an organization's innovation capability is enhanced (Alwis and Hartmann, 2008; Swan et al., 1999). The researcher would like to suggest that the CSIR's fairly rigid hierarchical structure and top management's control of all work processes affects staff motivation and impedes knowledge application for innovation. It is thus important that the CSIR's KM strategy should pay specific attention to creating the right culture and organizational structure that stimulates knowledge application for innovation purposes.

The researcher argues that the lack of specific KM guidelines at the CSIR makes it difficult for employees to effectively manage knowledge in their work environment. It was seen that the organized KM efforts are currently limited to the organization's research findings and conferences proceedings. It was further observed during the interviews that knowledge does not always flow freely in the organization – a number of respondents commented that the CSIR's top management was not good at exchanging knowledge and that the flow of knowledge from the institutes and other external subsidiaries is also often very poor. This is a worrying situation since the organization's expertise mostly resides within the individual research institutes and other external subsidiaries. It is further generally argued that knowledge is generated far more frequently at the research front level than at top management level (cf. for example Andersson et al., 2005; Hislop, 2005; Mudambi and Navarra, 2004). In summary it can be said that while on the one hand there is an urgent need for clear guidelines from senior management with regard to KM strategy development, on the other this should not be an authoritative process, but rather a consultative one.

7.5.3 Implementing a KM Strategy at the CSIR: Organizational Aspects To Consider

The next stage to apply the process outlined in the road map would be to consider various organizational aspects that would impact on the implementation of a KM strategy at the CSIR. The researcher again uses Heisig's (2001, 2009) framework (cf chapter 4.6) to discuss the impact of organizational factors on the KM implementation process. She further refers to Nonaka and Toyama's (2003) four conversion modes in her discussion.

- **Knowledge creation process**:

The findings indicate that institutional knowledge is primarily created in the CSIR during research conducted for projects and by means of the various training sessions held internally and externally.

During training, it is common that facilitators provide written documentation of the training materials for the participants. The training sessions attended by the employees can thus be seen as the process of creating explicit knowledge from explicit knowledge, i.e. the combination mode. Socialization happens when the mentors and /or trainers share their work experience, or tacit knowledge with the trainees. Externalization occurs when the trainees store their newly-acquired knowledge in a repository, e.g. website, portals, databases, etc. Internalization is the result of applying explicit knowledge through action and practice and in the process becoming the tacit knowledge of individuals. A problem occurs when, due to tight project timelines, such enabling activities are often regarded as a low priority.

During the research process knowledge is created when the researchers conduct experiments and integrate these with knowledge acquired from external information resources (e.g. the literature in the field) (combination and externalization). The final research findings are then made public and shared with colleagues and other stakeholders (socialization) and by means of research reports (combination) that are stored in

repositories (externalization). New knowledge acquired in this way is then in turn applied in other work processes (internalization).

- **Knowledge storage**:

Here two perspectives are considered: individual and organizational. From an individual perspective, knowledge is stored inside each individual's mind (Becerra-Fernandez et al., 2004; Mertins et al., 2001). Whenever an employee creates knowledge, he or she goes into the process of learning, i.e. the internalization process. From the organizational perspective, individuals are encouraged to document what they learn, and then store them in repositories, in order to prevent knowledge loss, i.e. the externalization process (Nonaka & Toyama: 2003). However, even though efforts are made to store knowledge, a problem arises with regard to how to effectively capture and store tacit knowledge. It is understood that not all tacit knowledge can be codified and made explicit - the focus, however, is on how to store the specific tacit knowledge that is deemed to be of importance for the execution of work processes in the CSIR.

- **Knowledge distribution**:

Employees should be encouraged to more actively share or distribute the knowledge they have generated or acquired as well as experience they have gained; i.e. the socialization process takes place. Such sharing of knowledge then in turn enables another individual to create new knowledge. It was however mentioned earlier that enabling or sharing sessions are not highly prioritized at the CSIR – it was observed during the interviews that the reason for this is the tight project timelines these sessions are therefore frequently postponed.

It is further acknowledged that informal meetings, while very valuable for tacit knowledge sharing, are however, difficult to manage. There is also the question of how to effectively share tacit knowledge. It is often impossible to completely transfer tacit knowledge - such knowledge sharing is very dependent on an individual's good communication skills, experience and wisdom. It is however recommended that although often problematic, the

CSIR's management should encourage such informal meetings as part of the socialization process as it is argued that it would help to improve productivity and organization's general effectiveness (cf. also comments made by Nonaka & Toyama, 2003). Employees should further also be expected to actively contribute to the institutional knowledge base by updating the organization's portals and databases with knowledge acquired during training sessions, when conducting new research, etc.. Such contributions would enable the internalization and combination processes (Nonaka and Toyama, 2003).

- **Knowledge application**:

The findings of the study confirms the argument of Mertins et al. (2001, p. 4) that knowledge application is in fact ''the most essential task of knowledge management'' as it triggers the whole knowledge cycle and affects all KM processes. Knowledge application at the CSIR mostly relates to the application of such knowledge when employees participate in research projects and particularly when they encounter problems they have to solve when the latter occurs, they often ask their colleagues for assistance, consult the literature in the field, or request to attend a formal training session to enhance their knowledge. This indicates, as suggested by Heisig (2001), that the knowledge application process undoubtedly triggers the knowledge creation process.

As mentioned before, it is evident that while the CSIR does to a certain extent engage with knowledge management in its daily activities it has not been fully implemented. The KM strategy and implementation plan that is being proposed in this dissertation is a step in the direction to encourage the CSIR to reap the benefits of knowledge management by systematically incorporating KM practices in all its activities.

Having argued for the full and structured implementation of KM at the CSIR, the researcher however also wishes to highlight possible barriers to such implementation:

- The unavailability of mentors could impede the knowledge creation process.
- It remains a problem to effectively capture and further properly store tacit knowledge.

- An obstacle to the process of knowledge transfer could be the fact that all employees are working against deadlines and that there is generally insufficient time to attend or organize knowledge transfer sessions. Consequently, these sessions would mostly be carried out on an informal basis.
- Another issue that needs resolving with regard to the knowledge distribution process is finding a way to effectively share tacit knowledge. Although it is understood that one cannot completely transfer tacit knowledge, the organization can still focus on transferring the tacit knowledge that is deemed important for project execution.
- Finally, a barrier to the knowledge application process may be the fact that employees often do not know how best to apply their own knowledge when working on a project.

Having identified possible problems that may occur in KM implementation, the researcher is however still convinced that the problems can be overcome and that the CSIR would derive considerable benefit if knowledge management were to be implemented in a more structured way. She therefore recommends that the CSIR should seriously engage with strategizing to fully implement knowledge management. Not only would knowledge management enable the CSIR to enhance its capabilities, innovate more effectively and improve working processes, but it would also prevent knowledge loss.

7.5.4 Innovating through Knowledge Management

The last stage to implementing the process outlined in the road map would be '*Innovating through Knowledge Management*'. In a knowledge setting, according to Davenport and Prusak (1998:149), attempts are made to

- measure and improve the value of intellectual capital
- build awareness and cultural accessibility
- change organizational behavior as it relates to knowledge and
- improve the knowledge management procedure.

Organizations that operate in a knowledge environment require knowledge-related employee behavior in all work activities. The findings clearly indicate that the CSIR has the potential to fully embrace KM – the nature of the CSIR's work setting already provides a favourable knowledge environment (cf. chapter 6.4). Nonaka and Takeuchi (1995:6) have linked innovation of new products and services to the accumulation of knowledge from internal and external sources and they give the example of Japanese companies that have brought about innovation by integrating internal knowledge with that acquired externally. In such organizations, knowledge that is accumulated externally is shared widely within the organization and incorporated in the organization's knowledge base. Nonaka and Takeuchi further argue that continuous innovation leads to competitive advantage.

From the findings, the researcher identified at least two types of innovation that could take place in the CSIR:

1. Technological (e.g. in terms of the use of KM technologies); and
2. Organizational (e.g. in terms of developing a knowledge culture and motivating staff to more actively engage in knowledge generation, transfer and application).

The research project has indicated the importance of establishing organizational objectives that incorporate a knowledge culture and the key role that leadership plays in setting individual employees' objectives. The researcher suggests that without the creation and acquisition of new knowledge, it would not be possible for the CSIR to innovate and/or produce new services. The researcher thus suggests that the CSIR, need not only to prioritize, but more importantly to redesign information flows in order to support both managerial work processes and those of individual employees.

7.7 Reflection and Future Research

This study has by no means provided a definitive answer addressing all the issues in the complex field of knowledge management. However, the results presented in this study have shown that knowledge, although not formally organized, is being generated, acquired, stored,

used and disseminated in the CSIR. This confirms that knowledge, whether managed or not, will always flow in any organization whether through formal or informal means. The results of the study have also shown that in the CSIR, management and researchers do not as yet fully recognize the value of knowledge and expertise as important assets that may be systematically organized and updated over time.

In the process of conducting the research project, a number of issues surfaced that needs further investigation:

- More research is required to ensure the effective implementation of knowledge management in the CSIR;
- Information and communication technology aspects need to be researched in greater detail, particularly in the way that they relate to the best way of developing an organizational memory base;
- The promotion of the free flow of knowledge in the organization needs more research and
- Further research needs to be conducted on how the organizational sharing culture could be enhanced to support knowledge management initiatives.

Incorporation of Knowledge Management in the CSIR

Wiig (1995:58) is of the view that many knowledge management methods complement various management initiatives. It is thus recommended that research be conducted to determine the best ways of combining knowledge management with managerial initiatives in the CSIR. Issues that could be investigated include amongst others how the organization should deal with the intellectual capital of employees and how the knowledge and skills available within the organization should be used to achieve organizational objectives.

Improving Information and Communication Technology

There is no doubt that the organizational culture in the CSIR presents a unique environment which may require unique methods and tools to supplement existing methods and ICT's applied in knowledge management. It is further evident that many such technologies may not be available in Ghana and may be too costly for the CSIR. Further research should focus on implementing appropriate technologies and tools to enhance knowledge management that are specifically oriented towards the local situation. Scarbrough and Swan (2001:4) are of the view that efforts to promote knowledge management often involve a repackaging of tools and practices which have been developed in a different context.

Promotion of the Free Flow of Knowledge

Several factors act as impediments to promoting the free flow of knowledge in the CSIR. Ellis (2005:55) is of the opinion that where employees cannot get access to key knowledge, they are likely to be less efficient, and where organizations lag behind in terms of what they collectively know, they are destined to be less innovative. It is recommended that research be conducted on how to enable employees to obtain access to the key knowledge they require to improve their performance and in the process enable the organization to be more efficient.

The CSIR's Knowledge Sharing Culture

Knowledge sharing in any organization must be motivated by management. Management in the CSIR may be willing to motivate knowledge sharing, but they may not know how to do it effectively. A further obstacle may be that employees could feel threatened by such a culture - for example, they may imagine that by sharing knowledge their expertise may become explicit and they may be replaced, they may be wary of criticism, or of exposing that they have insufficient knowledge. It is recommended that research should be conducted on how to promote knowledge sharing without making employees feel insecure and on how to provide incentives for employees to share knowledge freely.

7.8 Conclusion

In conclusion, this study has demonstrated that even though the CSIR does not have a formal knowledge management programme in place as yet, knowledge does flow through the organization. It is further argued that knowledge management can be practiced even when there is a lack of appropriate information communication technologies and that this aspect should not prevent the CSIR from organizing the knowledge they generate and acquire. as

The study has however also shown several factors are acting as an impediment to promoting knowledge-related activities in the CSIR. The researcher therefore suggests that to overcome these obstacles and establish an enabling environment the following should b instituted:

- Formulating knowledge management sharing policies that are user-friendly and can promote knowledge and information sharing in the CSIR.
- Hiring senior managers who are capable of providing visionary leadership and a culture of knowledge sharing and use.
- Providing incentives which are likely to promote knowledge creation and sharing in the organization. Employees of CSIR should receive recognition and be rewarded for creating knowledge, sharing knowledge and for acquiring new relevant skills, knowledge and capabilities.
- Senior employees of CSIR should understand that researchers who are expected to create, share and manage knowledge require independence as well as interaction so as to be effective.
- Researchers at the CSIR are knowledge workers and as knowledge workers they need to interact at each stage of the knowledge work cycle. Knowledge workers also need to have the opportunity to collaborate with their counterparts internally and externally to the organization. Bureaucracy, which is common in the CSIR, may not favor interaction and collaboration between employees.
- Senior employees in the organization should try to create knowledge-friendly environments which promote openness, trust and flexibility.

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APPENDICES

Appendix A

Questionnaire

Research Topic**:** Optimizing knowledge management for change and innovation in CSIR

Initiate the questionnaire with the following introduction

Knowledge Management is the process where an organization creates value from its intangible assets. This process deals with how best an organization captures, secures, distributes, coordinates, retrieves, stores and manages the organization's knowledge assets so that these assets are well leveraged both internally and externally.
The aim of this survey is to investigate the role of knowledge and the status of knowledge management within the CSIR to increase the quality of products and services, and promote innovations. Based on the investigation and recommendations that evolves, the best knowledge management practice model would be suggested for onward implementation in the CSIR.

Thank you for taking the time to complete the following evaluation on knowledge management. Your feedback is important to this research project. This survey is anonymous and your responses will be held in the strictest confidence. Thank you for your thoughtful feedback.

SECTION ONE – Background Information and Profile

1. **Your name (optional): ……**
2. **Department: ……..**
3. **Position: ……**
4. **Number of years in CSIR: ……**
5. **Age bracket (Please tick one)**

   a) Below 30 ☐

   b) 31 ---- 50 ☐

   c) 50 ---- above ☐

6. Gender (Please tick one)

a) Male ☐

b) Female ☐

7. Highest educational level (Please tick one)

a) High school / Certificate/ Diploma ☐

b) Bachelor degree ☐

c) Masters degree ☐

d) PhD ☐

e) Other (specify**)** **……**

Please read through each of the following statements and tick in the box that best describes your organization. Additional information in the form is welcome.

SECTION TWO	**STRUCTURE, CULTURAL AND SOCIAL PRACTISES**				
	Strongly Agree [5]	**Agree [4]**	**Strongly Disagree [3]**	**Disagree [2]**	**No idea [N/A]**
1. Knowledge and Information flows freely at the CSIR as people do not hold on to information that might be useful to others					
2. Decision making and relationships are not based on hierarchical top to bottom structure					
3. New innovative ideas are encouraged and implemented					
4. There is an open- door policy for information sharing between directors and staff					
5. CSIR encourages informal and formal opportunities for					

individuals within the organization to share with others their experiences regarding work issues					
ADDITIONAL COMMENTS					
SECTION THREE	**ORGANIZATIONAL PRACTISES AND PROCEDURES**				
	Strongly Agree [5]	**Agree [4]**	**Strongly Disagree [3]**	**Disagree [2]**	**No idea [N/A]**
6. Researchers who travel to conferences are mandated to produce a report					
7.ConferenceReports produced are evaluated and analyzed to identify what has been learnt and recommendations made to improve efficiency					
8. lack of time and human resources hinders knowledge and information sharing between staff and stakeholders					
9. Stakeholder have direct communication with the CSIR in order to monitor project performance					
10. The organization has systematic databases of all its main areas of work activities which can enable staff and stakeholders to identify expertise in the organization					
11. Staff who leave the organization go through systematic recorded de - briefing to ensure the organization retains as much as possible of their knowledge					

and contacts					
ADDITIONAL COMMENTS					
SECTION FOUR	**INFORMATION & COMMUNICATION TECHNOLOGIES**				
	Strongly Agree [5]	**Agree [4]**	**Strongly Disagree [3]**	**Disagree [2]**	**No idea [N/A]**
12.The CSIR has online mechanisms to enhance knowledge sharing					
13. The CSIR technology is well built to support the organization's knowledge exchange when staff are out of the office					
14. Information captured on the CSIR network is easily and readily available to staff and stakeholders					
15. The technology provides access to both general and specific interactive tools such as best practice databases, collaborative tools e.g. Skype, D space, groupware, Google docs					
	GENERAL				

16. what in your opinion hinders the free flow of knowledge in the organization	
17. suggest methods that would promote the access to knowledge within the CSIR	

Appendix B

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28 May 2012

Dr Salifu,
Director General
CSIR, P.O. Box M 32,
Accra, Ghana

Dear Dr Salifu,

MPhil research: Owusu-Bennoah, Yaa (OWSYAA001): Optimizing knowledge management for change and innovation in the Council for Scientific and Industrial research (CSIR) Ghana

I herewith wish to request your support for the intended research project of our MPhil student, Ms Yaa Owusu-Bennoah. She would like to investigate various knowledge management factors at the CSIR Ghana which could result in enhanced knowledge generation, sharing and use. This in turn could benefit innovation and productivity at the CSIR.

We request your permission for her to conduct interviews with a small staff sample and to distribute questionnaires to a larger sample. She will at all times adhere to the research, ethical and confidentiality requirements imposed by your Institution and our University.

We would be most appreciative of your support as we see this as not only as an opportunity to enhance knowledge generation and utilization at the CSIR, but also to provide the opportunity for co-operation between our two countries.

Yours sincerely

Dr J G SMITH
MPhil Supervisor

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
HEAD OFFICE

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Our Ref: CSIR/048/SF.7/VOL.12/C

Date: 25th November, 2010

Dr. J.G. Smith
Dept. of Information & Library Studies
University of Cape Town
South Africa

Dear Sir,

RE: MPHIL RESEARCH: OWUSU-BENNOAH YAA (OWSYAA001): OPTIMIZING KNOWLEDGE MANAGEMENT FOR CHANGE AND INNOVATION IN THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) GHANA

We write with reference to your letter dated November 23, 2010 on the above-mentioned subject matter.

I wish to inform you that permission has been granted to enable Miss Yaa Owusu-Bennoah conduct interviews with staff of the CSIR in connection with her MPhil Thesis on the subject *"Optimizing Knowledge Management for Change and Innovation in the Council for Scientific and Industrial Research (CSIR) Ghana."* from December 1-15, 2010.

We are expectant that this exercise will enhance cooperation between our two institutions and knowledge generation and utilization within the CSIR.

By a copy of this letter, Miss Owusu-Bennoah is hereby permitted to conduct the interviews as scheduled.

Sincerely yours,

Kwabena A. Nketia
Director of Finance/
Ag. Director of Administration
For: Director-General

Cc: Miss Yaa Owusu-Bennoah ✓
P.O. Box CT 3370, Osu-Cantonments
Accra

all yellow marked tables have a p < .05 & are statistically significant							
Institution	**Average of Experience sharing (p=0.010462)**		**Institution**	**Average of Knowledge flows**		**Institution**	**Average of Innovative ideas**
FRI	5.3		FRI	6.6		FRI	4.6
ARI	5.5		ARI	4.9		ARI	5.5
CRI	5.6		CRI	4.8		CRI	4.7
INDUST.	3.6		INDUST.	4.8		INDUST.	4.4
INSTI	5.6		INSTI	4.8		INSTI	4.7
SRI	3.4		SRI	4.2		SRI	4.4
STEPRI	3.5		STEPRI	4.8		STEPRI	3.6
WRI	4.8		WRI	5.3		WRI	4.5
Grand Total	**4.8**		**Grand Total**	**5.1**		**Grand Total**	**4.6**
p < .05							
Position	**Average of Experience sharing (0.043797)**		**Position**	**Average of Knowledge flows**		**Position**	**Average of Innovative ideas**
Jnr	6.0		Junior	4.0		Junior	4
Middle	5.4		Middle	5.0		Middle	5
Senior	4.3		Senior	5.2		Senior	4.4
Grand Total	**4.8**		**Grand Total**	**5.1**		**Grand Total**	**4.6**
p < .05	high-low		p < .05	low-high		none	
Department	**Average of Conference reports (0.038509)**		**Department**	**Average of Information available (0.009509)**		**Department**	**Average of Knowledge flows**
Tech. Transfer	3.2		Tech. Transfer	4.6		Tech. Transfer	4.8
Research	4.0		Research	6.0		Research	5.2
Grand Total	**3.7**		**Grand Total**	**5.5**		**Grand Total**	**5.1**
p < .05							
Education	**Average of Information available (0.043390)**		**Education**	**Average of Knowledge flows**		**Department**	**Average of Decision making**
Bachelors	6.5		Bachelors	5.5		Tech. Transfer	5.8
Masters	5.0		Masters	5.0		Research	6.2

Institution	Average of Open door policy
FRI	4.9
ARI	5.6
CRI	5.0
INDUST.	4.0
INSTI	5.0
SRI	5.0
STEPRI	3.2
WRI	5.0
Grand Total	**4.8**

Institution	Average of Lessons learnt
FRI	5.8
ARI	4.9
CRI	5.0
INDUST.	4.2
INSTI	4.9
SRI	6.0
STEPRI	6.7
WRI	5.4
Grand Total	**5.2**

Institution	Average of Projects monitored
FRI	3.8
ARI	6.0
CRI	4.9
INDUST.	4.4
INSTI	4.2
SRI	4.4
STEPRI	4.0
WRI	4.3
Grand Total	**4.5**

Position	Average of Open door policy
Junior	4
Middle	5.3
Senior	4.6
Grand Total	**4.8**

Position	Average of Lessons learnt
Junior	2
Middle	5.0
Senior	5.4
Grand Total	**5.2**

Position	Average of Projects monitored
Junior	4
Middle	4.9
Senior	4.3
Grand Total	**4.5**

none

low-high

none

Department	Average of Time & sharing
Research	6.3
Tech. Transfer	5.9
Grand Total	**6.1**

Department	Average of Projects monitored
Tech. Transfer	4.3
Research	4.6
Grand Total	**4.5**

Gender	Average of Knowledge flows
Male	4.9
Female	5.6
Grand Total	**5.1**